A PICTORIAL SURVEY OF CURRENT PRACTICE, EQUIPMENT AND MATERIALS

Construction Methods

TECHNOLOGY DEPT.

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JANUARY 1941 • ROAD BUILDERS' NUMBER

HIGHWAYS FOR NATIONAL DEFENSE

Military Access Roads
the No. 1 Highway Problem

Michigan Builds First
Defense Highway

Adapting Washington Roads
To Defense Needs

Columbia River Gorge Parkway
Has Strategic Importance

MURRAY-BALL CORPORATION, DETROIT, MICHIGAN — PRICE 50 CENTS

Capt. Howard Kizer, standing near the pilot house of the ice-coated Inland freighter, the Joseph Block.

Steel Sailors Battle

THROUGH TERRIFIC STORM

The wind had risen to a 75-mile gale, 50-foot waves crashed over freighter pilot houses, and at various points on Lake Michigan, ships were being battered to destruction. Through this terrific fall storm Captain Howard Kizer, of the Inland freighter *Joseph Block*, fought his way safely to the Inland docks at Indiana Harbor.

As the ship passed Little Point Sable near Ludington, the barometer began to fall, dropping to 28.40, a very dangerous level, and the wind shifted to the south. With the waves crashing perilously over the pilot house, Captain Kizer decided that he dare not head directly into the storm and so changed his course to take the full force of the sea at about four points on his beam. Despite this precaution, waves broke through the pilot house windows, the water freezing as it fell. The whole ship was sheathed with ice.

At the height of the storm, the freighter made no headway at all, but finally reached the west shore near Milwaukee, and arrived safely at Indiana Harbor eighteen hours late.

Less than 16 hours after arrival, the *Joseph Block* was again heading north for its next load, as usual.

This is only one instance of the many hazards encountered by the steel sailors of the Inland fleet. From the spring break-up of ice in the "Soo" until ice again locks the passage, these men navigate day and night through all kinds of weather to bring great tonnages of ore, limestone and coal to the Inland Mills.

Thus, ample stocks of uniform quality raw materials are always on hand and capacity production is assured.

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INLAND STEEL CO.

38 S. Dearborn Street, Chicago • Sales Offices: Milwaukee, Detroit, St. Paul, St. Louis, Kansas City, Cincinnati, New York

ANNUAL ROAD BUILDERS' NUMBER

Appearing on the eve of the thirty-eighth annual convention in New York of the American Road Builders' Association, this issue of CONSTRUCTION METHODS is devoted to subjects of highway interest. Succeeding issues will, as usual, deal with construction in all of its other branches. — Editor.

CURRENT JOBS

.... and Who's Doing Them

HIGHWAYS AND BRIDGES

Among recent highway and bridge contract awards are the following: Illinois: $333,081 to **Kesl & Sons Co.,** of Edwardsville. Indiana: $432,217 to **Calumet Paving Co.,** of Indianapolis. Kentucky: $208,352 to **Middle West Roads Co.,** of Indianapolis, Ind. Ohio: $564,426 to **Hallinger-Davidson Co.,** of Akron; $550,968 to **Launder & Son,** of Toledo. Pennsylvania: $1,275,908 to **Ralph Myers Construction Co.,** of Salem, Ind.; $395,633 to **A. Eidenmiller,** of Greensburg; $215,349 to **Putman & Greene, Inc.,** of Fort Wayne, Ind.; $451,592 to **Quarry Stripping & Construction Co.,** of Hazelton; $242,138 to **Eagle Construction Co.** and **Industrial Contractors,** of McKeesport. South Carolina: $262,458 to **W. L. Florence Construction Co.,** of Powder Springs, Ga. In Brooklyn, N. Y., **P. T. Cox Construction Co., Inc.,** of New York City, will erect bascule bridge over Gowanus Canal for $1,910,501. Contract for grade elimination work in Livingston County, New York, went to **Bero Engineering & Construction Corp.,** of North Tonawanda, for $254,416. **Arthur Gallow, Inc.,** of New York, received grade crossing elimination contract in Westchester County, N. Y., for $372,661. Another grade crossing elimination contract in Ohio went to **Hinton & Smalley,** of Celina, for $251,150; grade crossing elimination contract with New York Central R. R. in Cuyahoga County, Ohio, went to **National Engineering & Contracting Co.,** of Cleveland, for $312,835. Successful bidder for repairing and widening bridge over Jackson Lake Dam, Teton County, Wyoming, was **C. M. Smith,** of Thermopolis, for $36,936.

BUILDINGS

Public—In South Charleston, W. Va., **Carnegie-Illinois Steel Corp.,** of Pittsburgh, Pa., received contract for plant expansion, from Navy Department, at price of $45,000,000, including machine tools and equipment. **Stone & Webster Engineering Corp.,** of New York City, received contract for design and construction of TNT and DNT plant in Wilmington, Ill., for $20,137,000. Contract for naval ordnance plant, including large power plant, in Canton, Ohio, went to **Westinghouse Electric & Mfg. Co.,** of East Pittsburgh, Pa., for $16,000,000. **E. I. duPont de Nemours & Co.,** of Wilmington, Del., was awarded contract to construct ammonia plant in Morgantown, W. Va., for $15,000,000 on cost-plus-fixed-fee basis. In Philadelphia, Pa., **Cramp Shipbuilding Co.** was awarded contract for plant expansion with bid of $9,000,000 on cost-plus-fixed-fee basis. **McNeill Construction Co.,** and **Zoss Construction Co.,** both of Los Angeles, Calif., will erect 3,000 defense housing units, in San Diego, Calif., for $9,070,000. In Spartanburg, S. C., replacement center is under construction by **J. A. Jones Construction Co.,** of Charlotte, N. C., **Fiske-Carter Construction Co.,** of Spartanburg, and **Boyle Construction Co.** of Sumter, for $6,739,327. Housing project at Aberdeen Proving Ground, Aberdeen, Md., is under way by **Irwin & Leighton,** of Philadelphia, Pa., on cost-plus-fixed-fee basis.

Stone & Webster Engineering Co., of New York, was awarded contract to design and construct ammonia plant at Wilson Dam, Muscle Shoals, Ala., for $6,500,000. In Ravenna, Ohio, **Atlas Powder Co.,** of Wilmington, Del., will construct ammunition depot for $5,000,000. At Camp Ord, Calif., **Morrison-Knudsen Co.,** of Los Angeles, will erect temporary buildings, cantonment type, at cost of $5,997,948. Replacement center at Camp Wheeler, Macon, Ga., is under way by **Beers Construction Co.,** of Atlanta, and **W. L. Cobb Construction Co.,** of Decatur, for $5,434,880 on cost-plus-fixed-fee basis. Contract for barracks, mess hall, recreation rooms and officers rooms at Fort Eustis, Va., was awarded to **J. P. Pettyjohn & Co.,** of Lynchburg, **Dewey G. Weddie & Co.,** of Norfolk, and **Hofheimer Construction Co.,** of Norfolk, for $5,132,425 on cost-plus-fixed-fee basis.

CONSTRUCTION METHODS was founded in 1919, under the name of SUCCESSFUL METHODS, by the Manufacturers Publicity Bureau, Inc., of Chicago, representing a group of non-competing manufacturers of construction equipment. Charles R. Thomas, editor of the first few issues, was succeeded by William Jabine.

In 1926 the McGraw-Hill Publishing Company, Inc., of New York, purchased the publication, changing its name to SUCCESSFUL CONSTRUCTION METHODS in November of that year, to CONSTRUCTION METHODS in May, 1927, and to CONSTRUCTION Methods and Equipment in December, 1936. In October, 1939, the name CONSTRUCTION METHODS was resumed. All rights to the foregoing titles are reserved by the publishers.

Robert K. Tomlin was appointed editor of CONSTRUCTION METHODS in January, 1928. Vincent B. Smith is associate editor; N. A. Bowers, Pacific Coast editor; Nelle Fitzgerald, assistant editor; and Paul Wooton, Washington representative.

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ROBERT K. TOMLIN, Editor
A. E. PAXTON, Manager
Editorial Staff: Vincent B. Smith, Paul Wooton (Washington)
N. A. Bowers (San Francisco) Nelle Fitzgerald
A McGRAW-HILL PUBLICATION

The HOW of it

For the benefit of readers concerned with the practical application of method or equipment the following references are to articles or illustrations in this issue that tell:

How **FIRST MILITARY HIGHWAY** was built at army camp in Michigan. — p. 39

How **MILITARY ACCESS ROADS** constitute nation's No. 1 defense highway problem. — p. 42

How **WIDE SHOULDERS** on existing highways are built to serve military needs. — p. 43

How **SPREADER-ROLLER** applied chips to Canadian airport runways. — p. 45

How **DE-AIRED BRICK** was used to pave vehicular tunnel roadways. — p. 46

How **SCREED PULLED BY TRUCK** leveled off sand-mastic cushion for brick paving. — p. 47

How **STATE HIGHWAYS** in Washington are being adapted to nation defense needs. — p. 48

How **GRADATION CONTROL** assured aggregate uniformity in asphalt plant. — p. 50

How **DREDGED FILL** carried parkway through gorge. — p. 54

How **ROCK TOE WALL** retained dredge fill. — p. 55

How **OLD SLAB** was salvaged on highway widening project. — p. 56

How **CENTRAL CONCRETE CURB** was built to divide highway traffic. — p. 57

How **AIR HAMMER RIG** demolished old concrete slab. — p. 58

How **ASPHALT SEAL** prevented moisture changes in clay subgrade. — p. 59

How **FAST GRADING AND PAVING** saved one year on road relocation job. — p. 60

How **SPREADER-VIBRATOR** speeded concrete surface finish. — p. 63

How **SURFACE COLORING** was applied to concrete pavement. — p. 70

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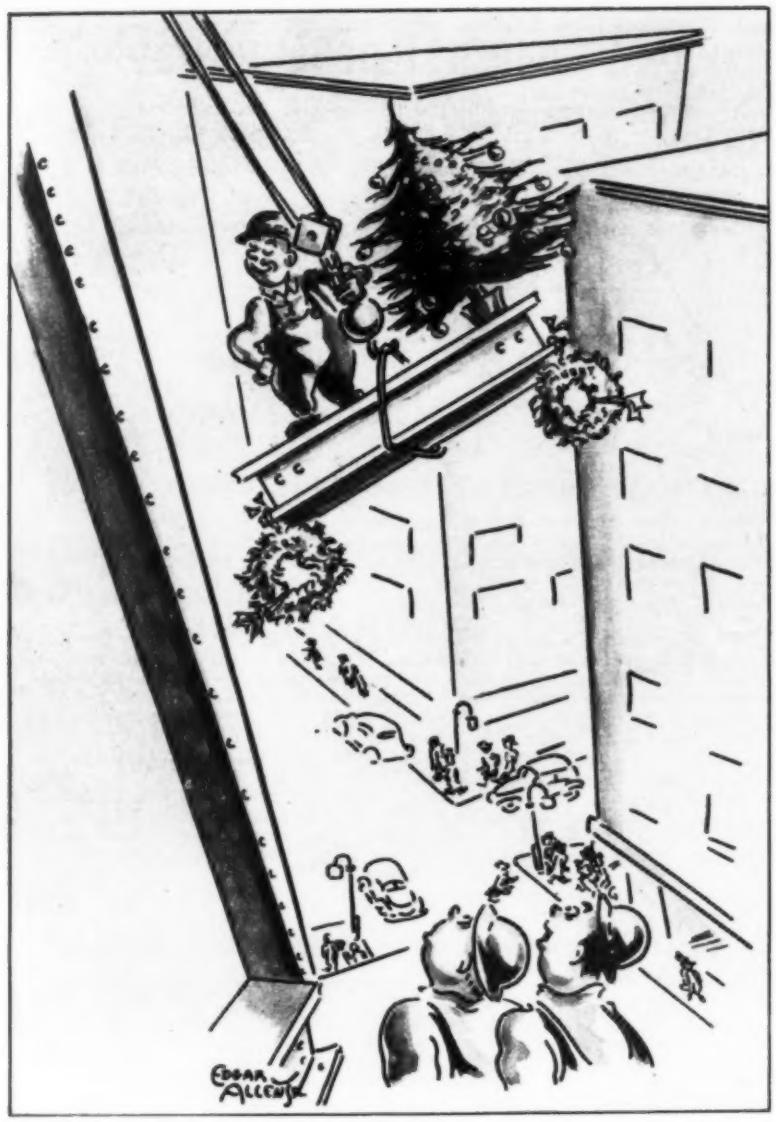
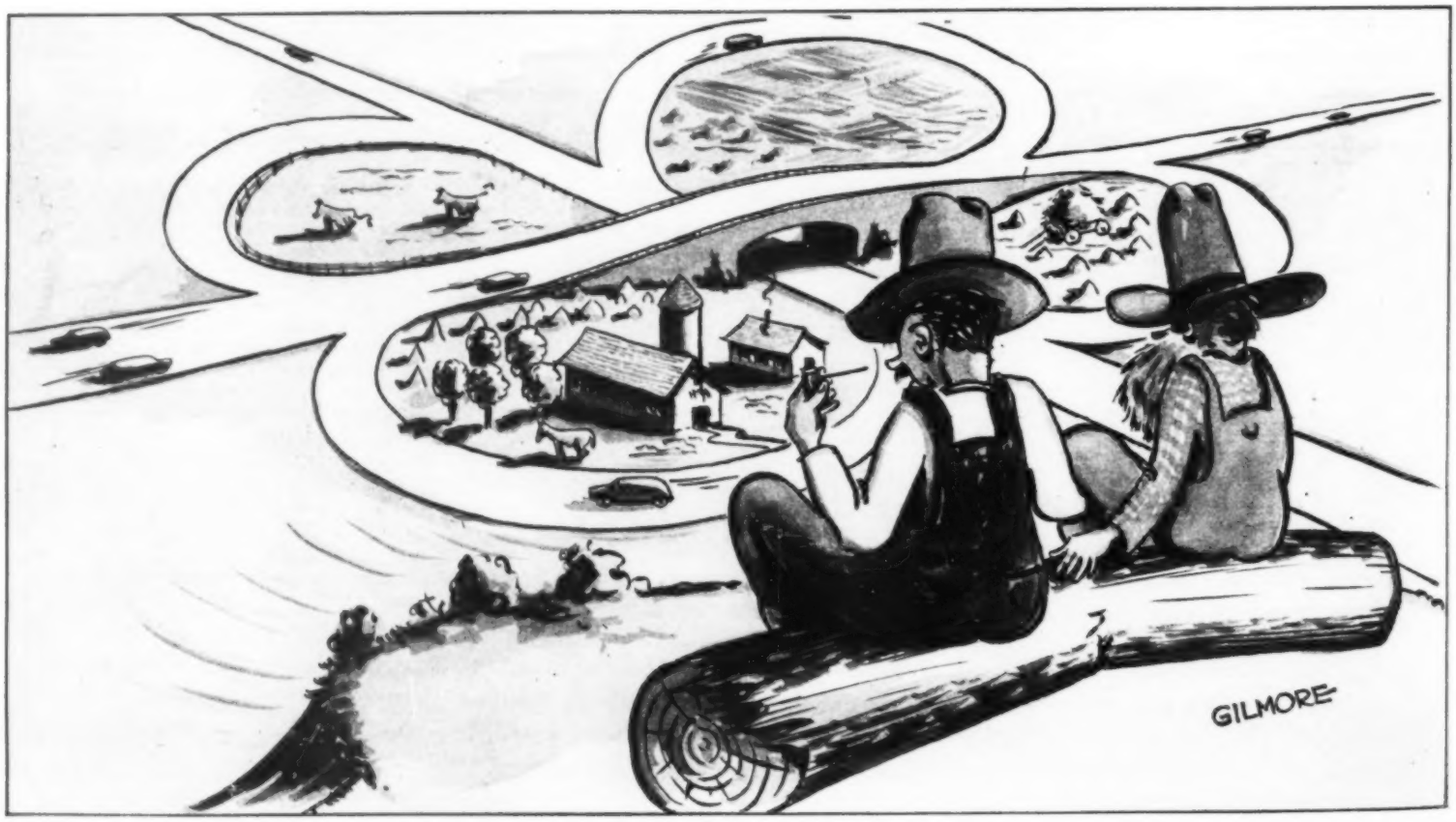
THE JOB JESTER

CARTOONS DRAWN FOR CONSTRUCTION METHODS



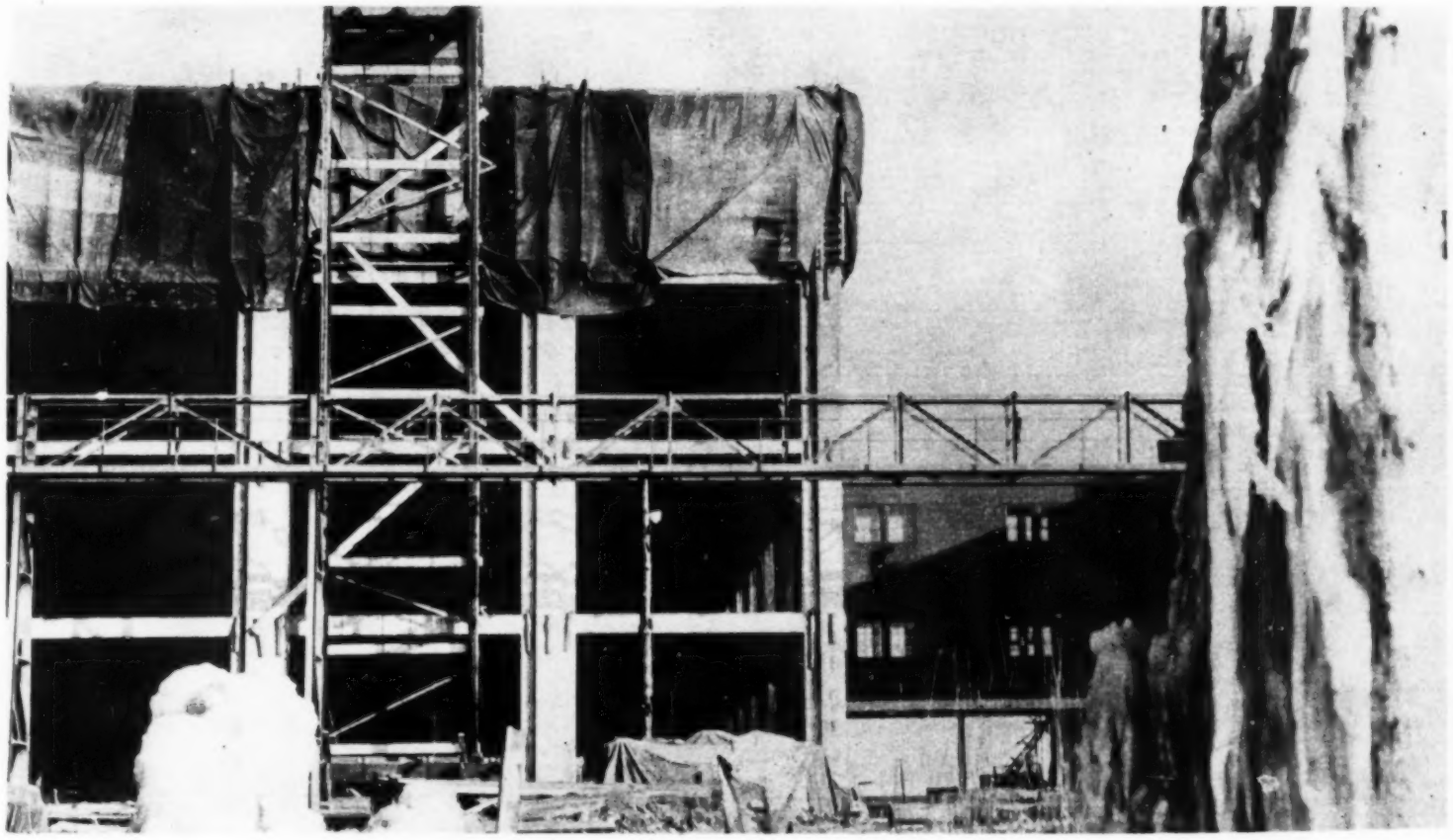
"O'Reilly always injects the Christmas spirit into things no matter where he is!"



"I always did want the old place subdivided."

Tech

'INCOR' 24-HOUR CEMENT SPEEDS WINTER WORK, REDUCES FREEZING RISK, CUTS HEATING COSTS



Cold-Weather Safety Factor

QUALITY PAYS . . . INSIST ON 'INCOR'—'Incor' 24-HOUR Cement means just what the name says—dependable 24-HOUR service strength. Plus long-time durability, proved by 13-year performance. Quality pays—because better cement makes better concrete.

WITH temperatures as low as 9° above zero, concreting proceeded at normal speed last winter, on 5-story addition to General Aniline Works' Building No. 48, Grasselli, N. J.—White Construction Co., New York, general contractor. The structure was designed for live loads of from 100 to 500 lb. per sq. ft. Economical 'Incor' concrete design mixes provided dependable high early strength, permitted form stripping in 2 days, without the use of reshores. *'Incor' saved $1,150 on heating-fuel expense, alone.*

'Incor' cures and hardens 5 times as fast, is safe from freezing that much sooner; that cuts heat-protection costs 50 to 60 percent, and permits normal stripping schedules with safety, even at sub-freezing temperatures.

Use 'Incor'* on work now in progress—it's a proven cold-weather safety-factor, sure enough. Write for copy of "Cold Weather Concreting." Lone Star Cement Corporation, Room 2261, 342 Madison Avenue, New York. *Reg. U. S. Pat. Off.

LONE STAR CEMENT CORPORATION

MAKERS OF LONE STAR CEMENT . . . 'INCOR' 24-HOUR CEMENT

TRAXCAVATOR*

EXCAVATES • LOADS
GRADES • STRIPS
BULLDOZES • LEVELS
CLEARS LAND • PULLS
BACKFILLS • CASTS
DIGS • REMOVES SNOW
SPREADS • DITCHES

GRADING AND LOADING—This model T-4 "TRAXCAVATOR" cuts grade for street and loads dirt at rate of 100 yards per hour.

STRIPPING—Another street job—stripping old pavement—loading, cutting new grade . . . single operation for a "TRAXCAVATOR".

BASEMENT EXCAVATI

PIONEER OF MODERN METHOD

LEVELLING—T-4 "TRAXCAVATOR" equipped with bulldozer blade levelling the site for a modern 500 family housing project.

SNOW REMOVAL — Loading as well as plowing snow means profitable work for "TRAXCAVATORS" even in bad weather.

"TRAXCAVATORS" are powerful digging and loading machines which are blazing new trails in the modernization of excavating, dirt moving and material handling. They combine in one machine the usefulness of many, and will do more kinds of digging and material moving jobs than any other single piece of equipment. "TRAXCAVATORS" are highly mobile — can travel around a job on their own power at speeds better than 5 miles per hour. Powered by "Caterpillar" track-type tractors and built in three sizes with bucket capacities from ½ to 2½ cubic yards. Ask your "Caterpillar" dealer to show you why a "TRAXCAVATOR" is the Pioneer of Modern Methods. For illustrated catalog write Trackson Company, Milwaukee, Wis., U.S.A.

* REG. U.S. PAT. OFF.

LOADING ROCK — On big dam "TRAXCAVATORS" also dig toe tra sort rock, etc. Best dam machine

BACKFILLING—On the job from st finish! "TRAXCAVATORS" not only dig and carry, but backfill and clean-up

TRAXCAVATORS ARE PROFIT-MAKE

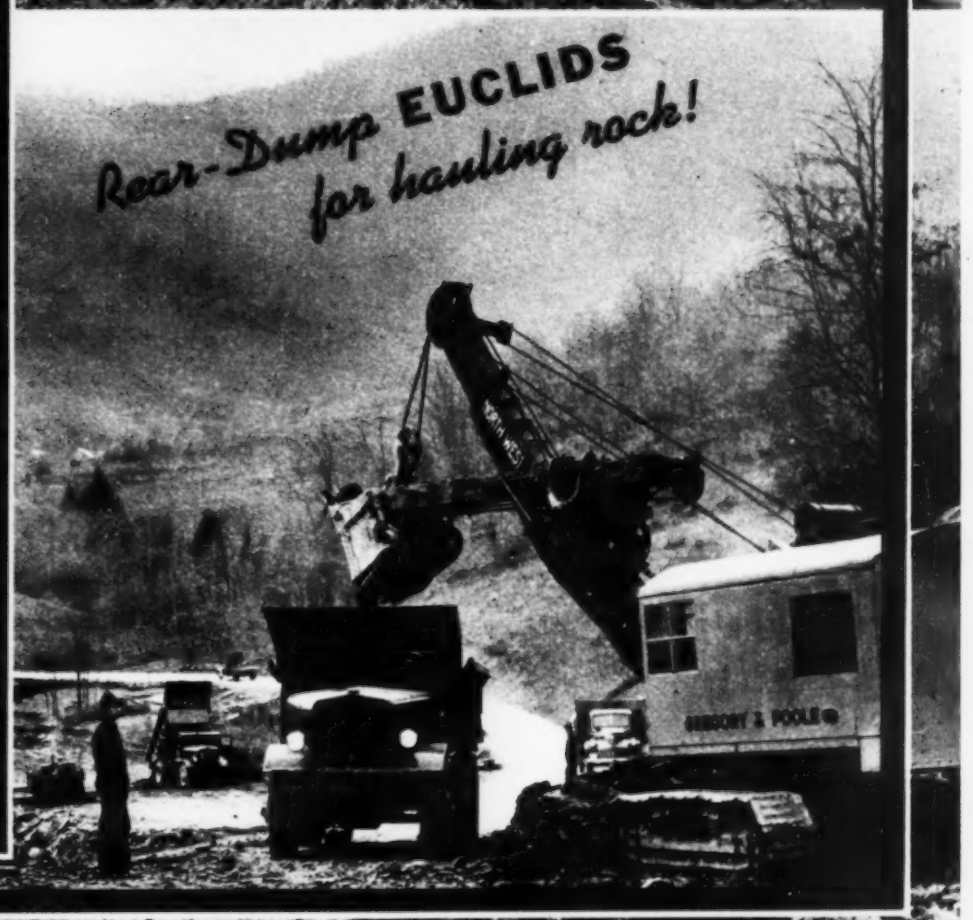
UNEXCELLED!

1 Near Hancock, Md. THOMAS, BENNETT & HUNTER Inc., used three 13-yard Bottom-Dump EUCLIDS to haul about 100,000 cu. yds., of unclassified excavation on a 1.28 mile highway relocation contract. . . Working under a 1½ Yd. shovel on hauls averaging 2600 feet one way, each of these Euclids hauled about 8 full buckets per load and made from 5 to 6 round trips per hour.

2 At Topton, N. C. GREGORY & POOLE are using three 15-ton Rear-Dump EUCLIDS to haul about 100,000 cu. yds., of heavy excavation on a 6.3 mile highway improvement contract. . . . Working on a shuttle operation with road traffic maintained, these large 10-yard Euclids have proved unequalled for this type of job.

3 These jobs are representative of scores of small and medium sized highway contracts throughout the country on which numerous contractors have learned — and proved — that more profit can be made with Rear-Dump EUCLIDS and Bottom-Dump EUCLIDS.

THE EUCLID ROAD MACHINERY CO.
Cleveland, Ohio

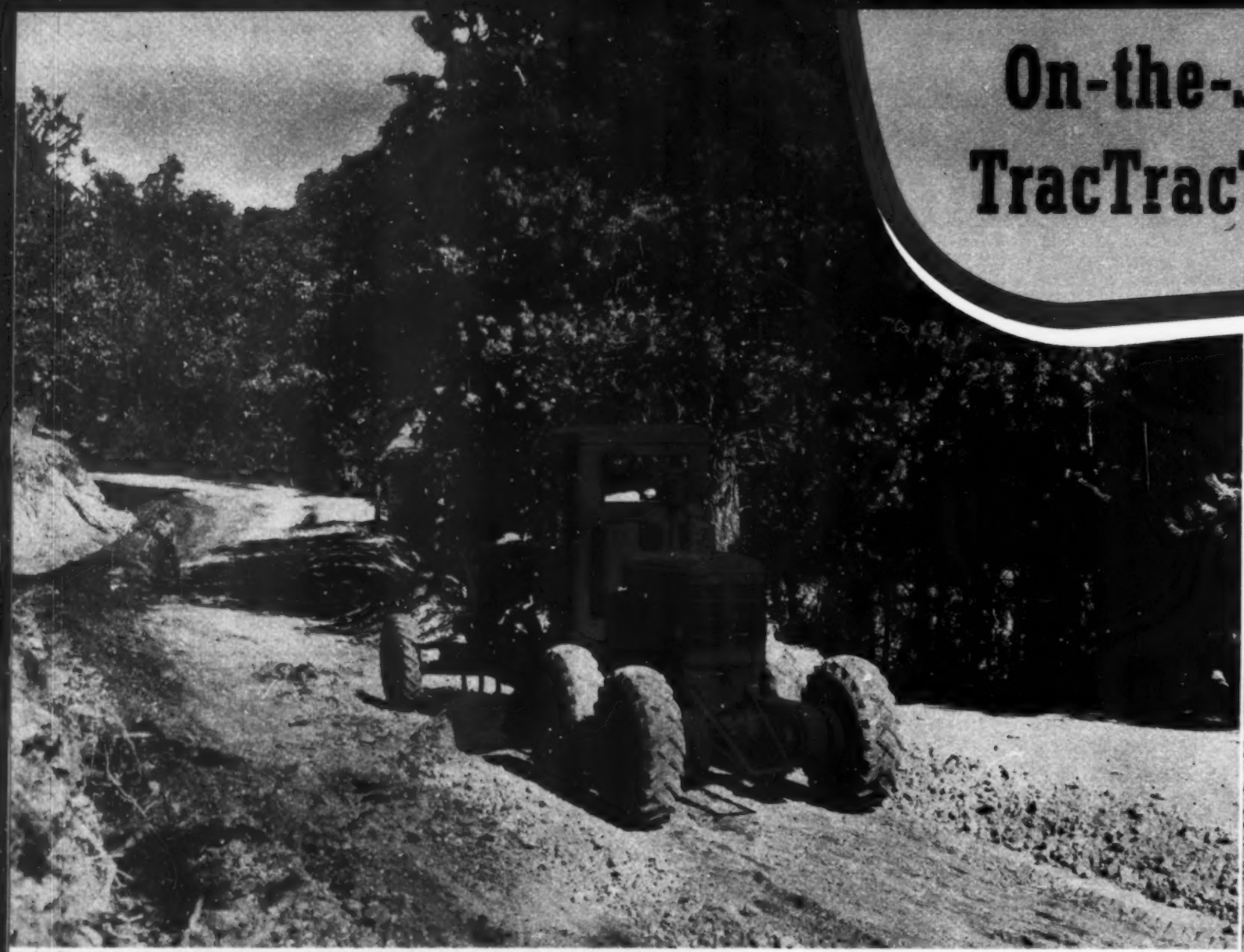


EUCLID

SELF-POWERED
EARTH • ROCK • COAL • ORE
HAULING EQUIPMENT
And — CRAWLER WAGONS • ROTARY SCRAPERS • TAMPING ROLLERS

EUCLID
THE PIONEER

On-the-Job TracTracTor



Above: Resurfacing a mountain road near Crestline, Calif., with an International-powered motor grader. The oiled surface of the old road was scarified and graded to one side, the windrow then graded back and forth to pulverize the material, and the pulverized material spread over the road again as a new surface.

Above: Backfilling a sanitary sewer with an International TD-14 Diesel TracTrac-Tor and bulldozer in Forest Hills, N. Y. This outfit is owned by the Sprague Equipment Co., Glendale, N. Y.

Right: Stumps, tangled roots, trash, and trees give way before the powerful thrusts of the International TD-18 Diesel and bullgrader, used for land clearing in Massachusetts.

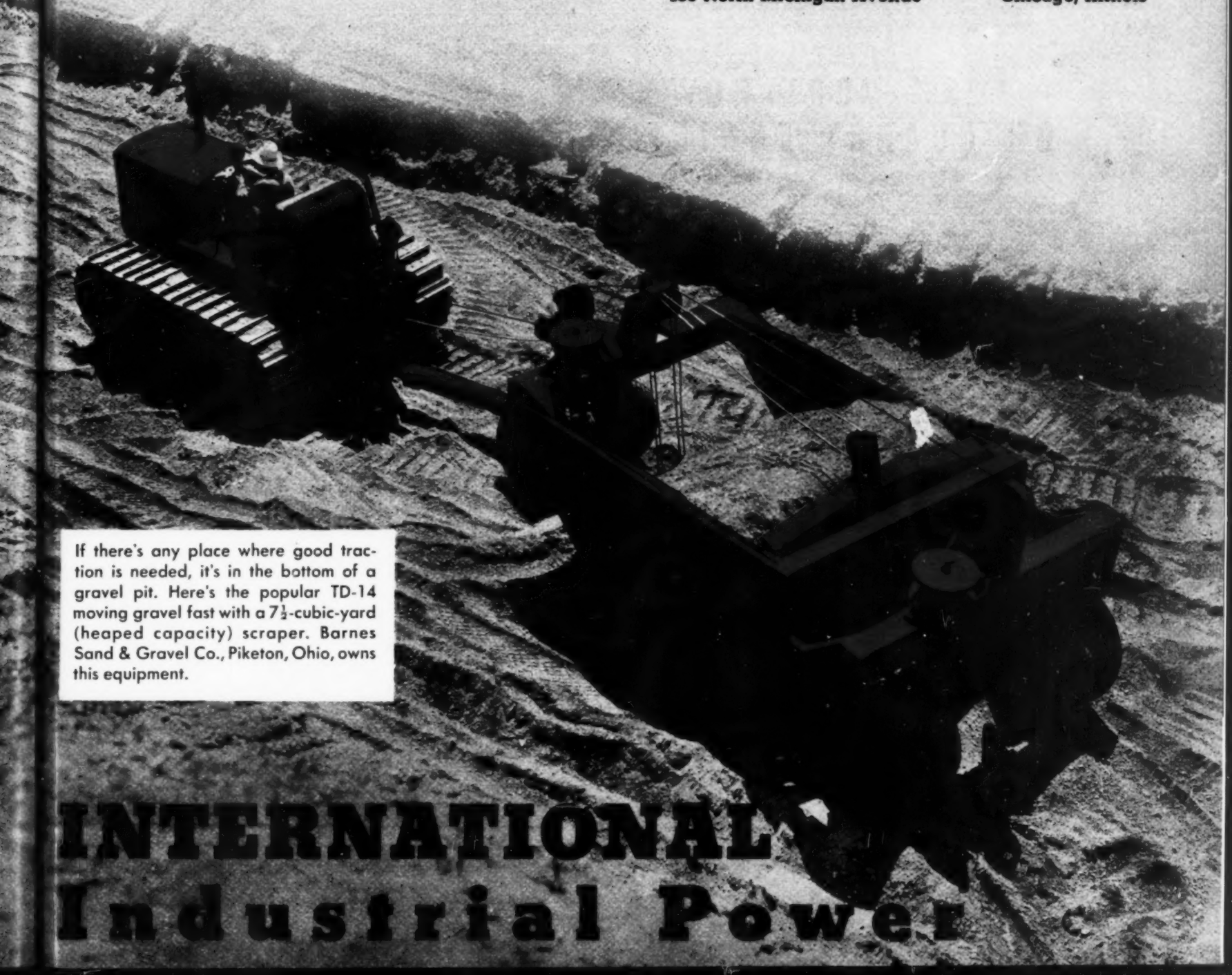
PERFORMANCE Explains International ACCEPTANCE!

● Enthusiasm for the New International Diesel TracTracTors grows by leaps and bounds. On job after job, TracTracTors are getting the call because of their work output, their ability to cut costs, their low maintenance, and their stamina to stand up under the toughest operating conditions.

A new year is ahead. The industry hums with activity, laying plans for the next 12 months. *Power* is the key to the speedy, successful completion of a good many jobs—power to get things done on time at the lowest possible cost.

The FOUR NEW INTERNATIONAL TRACTRACTORS have proved themselves able to fit into any project. Look into their record—and build your work program around these sound, reliable power partners. The nearby International industrial power dealer or Company-owned branch will give you complete details.

INTERNATIONAL HARVESTER COMPANY
180 North Michigan Avenue Chicago, Illinois



If there's any place where good traction is needed, it's in the bottom of a gravel pit. Here's the popular TD-14 moving gravel fast with a 7½-cubic-yard (heaped capacity) scraper. Barnes Sand & Gravel Co., Piketon, Ohio, owns this equipment.

INTERNATIONAL
Industrial Power

Part of the fleet of officials' cars and trucks operated by Greenlee Bros. & Co., machinery and tool manufacturers, Rockford, Illinois. The Standard Automotive Engineer's recommendations help the Equipment Superintendent keep this fleet at peak performance.

25% MORE POWER ON QUARRY ENGINES

"I thought it might interest you to know what your Automotive Engineer, Mr. Custer, accomplished when you sent him up here," writes Mr. H. E. Pint of Pints Soft Lime Products Company at Raymond, Iowa.

His letter continues: "Two of our 80 H.P., 6-cylinder engines were quite frequently unable to carry the load before Mr. Custer worked on them. Since he recommended changing air cleaners and carburetors and adjusted them with his instruments, I'd say our horsepower has been increased about 25%.

"On a check-up of gasoline consumption we find that in a ten hour run we use about a gallon an hour less.

"Thank you very much for this service."

"MUCH EASIER STARTING AT LOW TEMPERATURE" WRITES ROCKFORD FLEET OWNER

There's one man who is just as interested in your fleet operating problems as you are. He's not only concerned about the gasoline mileage you get or oil consumption; he's also thinking about maintenance costs and reliable operation. This man is the Standard Automotive Engineer in your locality.

Here's what usually happens when an operator lets this engineer help him "worry" about these fleet items. Greenlee Bros. & Co. of Rockford, Illinois, is a typical example and this is what Mr. F. M. Keig, Purchasing Agent of the company, reports:

"We want to take this opportunity to thank you for the engineering service given us by your Automotive Engineer, Mr. W. W. Cook, on our varied pieces of equipment.

"Since this service has been rendered, we have experienced much easier starting, especially at low temperature—far better all around performance—and an increase in miles per gallon; also our maintenance costs have been reduced considerably.

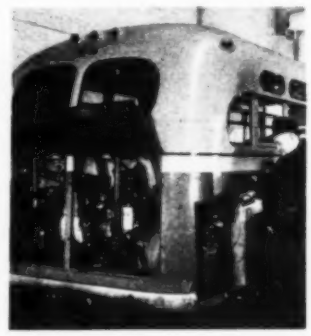
"Your engineering service and cooperation are greatly appreciated."

Ask a Standard Automotive Engineer what he does and what he thinks he can do for you to reduce operating costs.

A COMPLETE SERVICE FOR DIESEL BUS OPERATORS

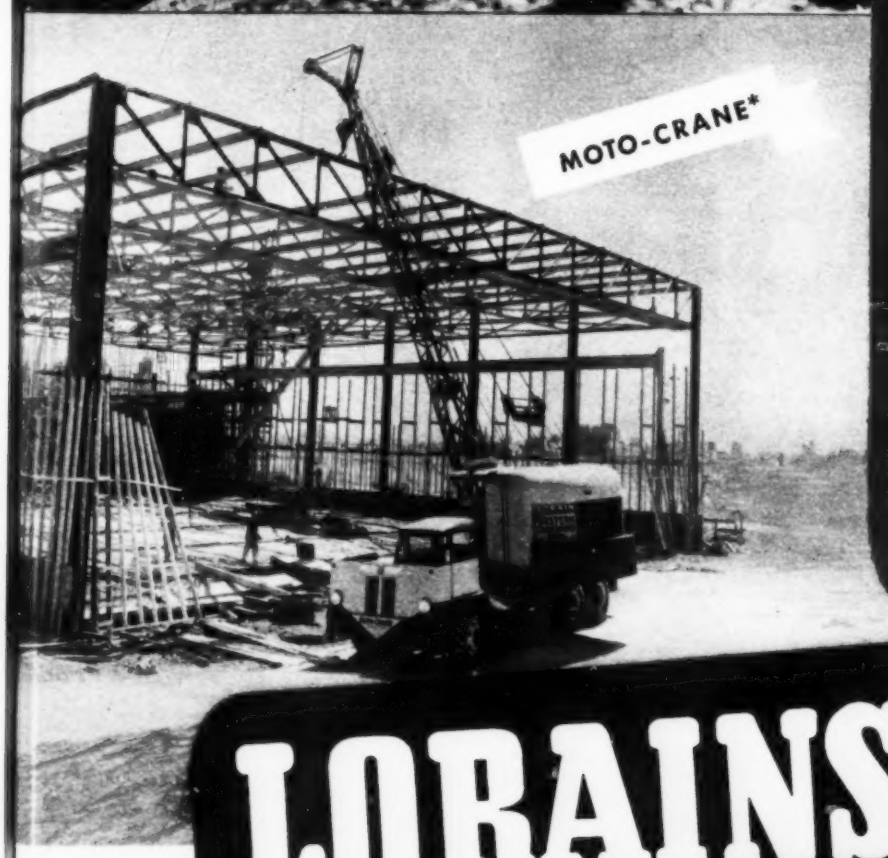
If you operate Diesel buses, undoubtedly you have found out that your maintenance department has a lot of new problems to meet.

Standard Automotive Engineers are thoroughly familiar with the operation and maintenance of Diesels. Their suggestions may be of considerable help to your maintenance department. Standard Oil products for Diesels are available throughout the Middle West. Use these products. Take advantage of this Engineering Service and get the full economy of Diesel operation. You can reach your Automotive Engineer through any local Standard Oil (Ind.) office or by writing 910 South Michigan Avenue, Chicago, or Standard Oil Co. of Nebraska at Omaha.



STANDARD OIL COMPANY (INDIANA)

AUTOMOTIVE ENGINEERING SERVICE *LOWERS MILEAGE COSTS*



19 WAYS TO MAKE MONEY IN '41

• Higher job costs and shorter time limits in '41 threaten profits unless specialized equipment is chosen and applied properly. That's why Lorain offers you a choice of 19 models—each and every one a specialist in its own field and designed to ***move more material, faster, at lower cost.***

Every unit in the Lorain line enjoys a top performance rating. Direct-to-the-point power transmission for handling tougher digging faster, increased capacities to handle more and heavier work, and a stronger, more simplified construction that insures continuous, low-cost operation—these three advantages are common to all Lorains because each is built to the proved principles of Center Drive design.

19 models, capacities from ⅜ to 2½ cu. yds.; crawler mounted units with interchangeable shovel, crane, dragline, clamshell, backdigger or skimmer booms; mechanized Moto-Cranes,* Moto-Shovels and Moto-Drags that travel and work on 10 rubber-tired wheels. Complete design and performance data on any or all of the machines making up the Lorain "Fleet" for '41 is yours for the price of a postal. Write today!

THE THEW SHOVEL COMPANY
LORAIN, OHIO

*TRADE MARK

THEW CENTER DRIVE

LORAINS 19 MODELS 3/8 TO 2 1/2 YDS.

Isaacson

ANNOUNCES!

The WHEEL-TOR

A sensational "PRIME MOVER" . . . Closes the gap between crawler tractor and truck operation. With 4-wheel drive and pneumatic tires it has speed, power and maneuverability. Proven tractor engine, proven tractor transmission, proven tractor steering and proven tractor final drive make this unit ideal for short, or long fast hauls over dirt and paved surfaces. Dependable service is assured by the use of STANDARD TRACTOR service and parts. Simplified IT IS A CONVERSION UNIT that replaces only the track frame and the crawler tracks using the crawler tractor chassis for its power unit with tractor steering and tractor maneuverability.

POWER with SPEED

ADAPTABLE FOR MANY USES — SPEEDS UP TO 20 MILES PER HOUR

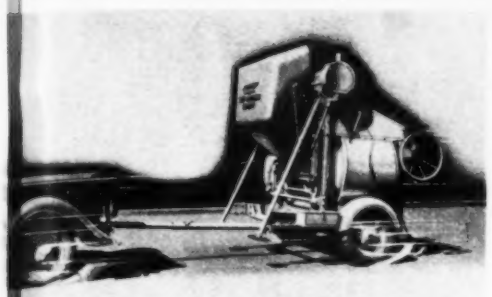
THE WHEEL-TOR IS NOT A SINGLE PURPOSE MACHINE

U. S. and Foreign Patents Pending

ISAACSON IRON WORKS

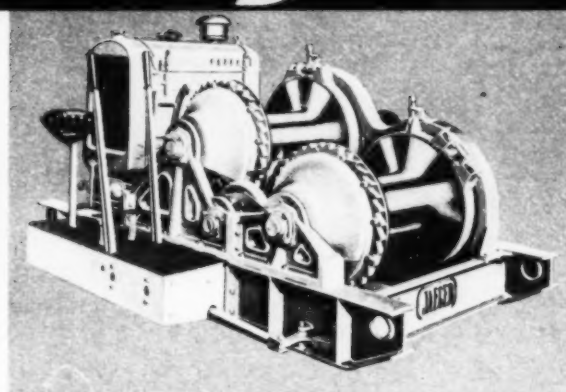
Seattle

JAEGER Offers 9 Types of High Production Tools for Contractors



: CONCRETE, MORTAR, PLASTER MIXERS:

Fast End-Discharge SPEED-LINE Trailers up to 14S size with Automotive-Type Transmission. Machined Steel Drum Tracks. Plant Mixers to 56S Size —Tilters, Plaster Mixers. Portable Cold-Mix Plants. Outsell all others on speed, dependability. Ask for catalog, prices.



2: "Touch Control" HOISTS

Most advanced type on market—Giant Expanding Clutches give effortless control. Anti-Friction bearings, balanced drums, 50% stronger. Sizes 5 to 100 H.P., one to three drums, gas, electric, diesel. Get our low price on 17 to 36 H.P. Builders Hoist.

3: PLACING Equipment

Self-Raising Tower cuts placing costs. Full ton capacity, portable on job, heights to 67 ft. Mast plants, towers to 500 ft.

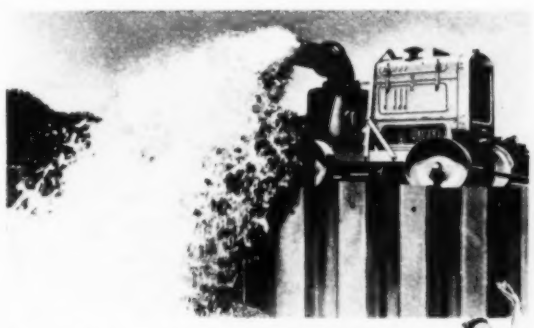
"Easy Dump" Carts

Sizes to 11 cu. ft.—perfectly balanced—extra strong. Ask for catalog. Low prices.

: TRUCK MIXERS nd "AUTO PAVERS"

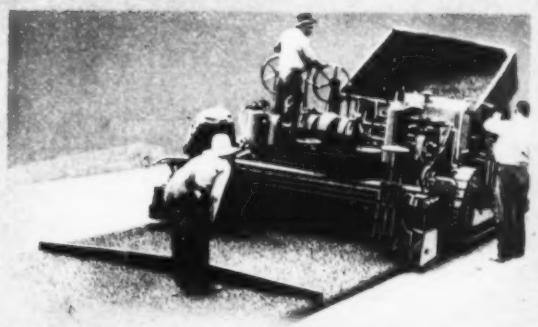
egers far outsell all others because of fast- operation, quality of mix and minimum aintenance. Both "LOW CHARGE" and IGH DUMP" types of Truck Mixers. Agita- s—sizes 2 to 8 cu. yds. Mobility, flexibility t job costs New catalog shows you how.

Auto-Pavers" with reader—the mobile ving plant.



5: "Sure Prime" PUMPS

Contractors buy more Jaeger Pumps than any other make. Prime automatically up to 5 times faster, pump huge volume, give thousands of hours extra service. Compact, portable. Capacities to 240,000 G.P.H.; gas, electric. Also Jetting Pumps, Road Pumps.

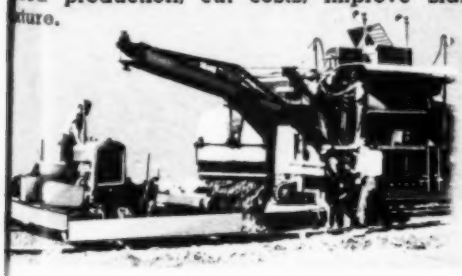


6: BITUMINOUS PAVERS

Adjustable up to 14 ft. widths—capacity over 100 tons an hour on many jobs. Smoother finish insured by long equalizing runners acting as movable forms. Puts no weight or traction on new-laid material. Cuts cost of laying stone, macadam, hot or cold mixes. Ask for catalog.

: CONCRETE SPREADERS

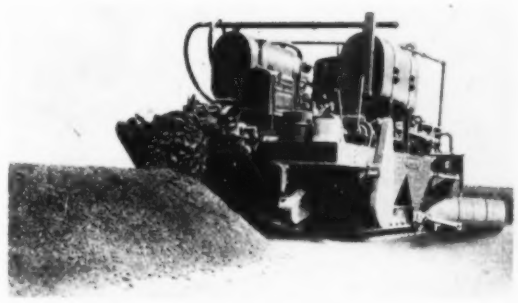
enty-five used on Pennsylvania Turnpike one—re-mix, spread, strike-off fast as dual- um pavers or "Auto-Pavers" can produce. eed production, cut costs, improve slab ture.



8: Type "H" De Luxe FINISHERS

Speed and traction easily match pace of 34E dual drum pavers and concrete spreaders. Single 4-Speed Transmission, new smoothness of finish, completeness of control. 4 ft. telescopic width changes built in. Ask for catalog.

FORM TAMPER: Does 6-to-8 man job of tamping under forms. Widely used.



9: MIX-IN-PLACE ROAD BUILDERS

Traveling pug-mills that mix in one pass. Model MP-2, Self-Propelled, mixes up to 16 cu. ft. windrows, 150-180 tons an hour of heavy mat or stabilized base. Accurately measures bitumen or water. Can be equipped to spread and strike-off. Model MP-1, Tractor Drawn, mixes and smoothly lays over 3 miles of retread a day. Popular price.

THE JAEGER MACHINE CO.

800 DUBLIN AVENUE
COLUMBUS • OHIO

Wire went to work f

when John A. Roebling made America's first w

ELEVATOR ROPES
for applications ranging from private residence "lifts" to high speed skyscraper elevators.

AERIAL TRAMWAYS
for passengers, freight, etc., including Patented Constam Ski-lifts illustrated above

MINING ROPES
for shaft elevators, steam shovels, drag scrapers, and other purposes.

MARINE ROPES
mooring lines, hawsers, hoisting rope, rigging, etc.

CONTROL CORD
for aeroplanes. Also guy wire, strand, fittings, and electric wire and cable.

SHOVEL ROPES
wire ropes for excavating equipment, cranes, hoists, and other rope-rigged machinery.

OIL FIELD LINES
for rotary and cable tool drilling and every other oil field use.

STRIP STEEL
cold rolled high carbon "flats" for unending uses from steel measuring tapes to corset stays.

WOVEN WIRE FABRICS
from window screens to fine metallic filter cloth or coarsest mesh sizing screens.

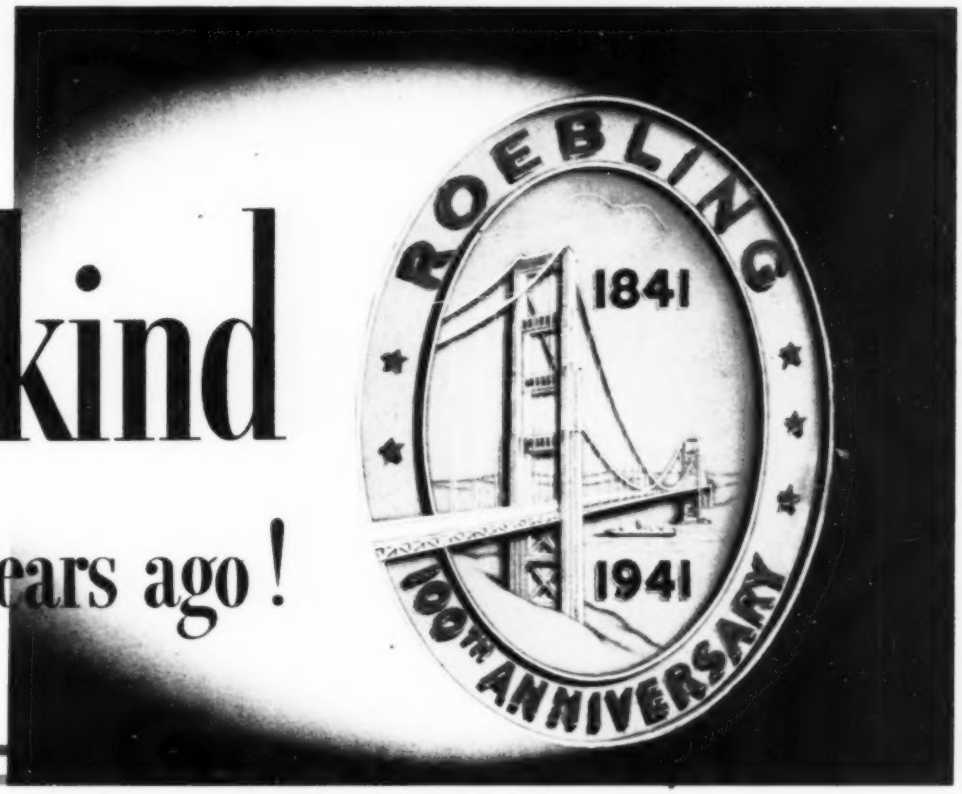
MAGNET WIRE
for electric motor, generator, and coil windings. Insulations for every need.

1841 FORWARD MARCH W

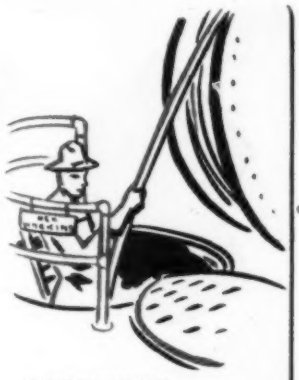
WIRE ROPE AND STRAND,— Preformed and Standard .....
FITTINGS...SUSPENSION BRIDGES AND CABLES...AERIAL WIRE ROPE
SYSTEMS...COLD ROLLED STRIP...ELECTRICAL WIRES AND CABLES

k for mankind

rst wire rope - 100 years ago!



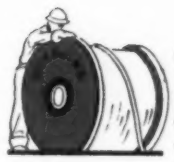
FLAT WIRE
cold rolled high carbon steel flat wire for shoe shanks, clocksprings, heddles, etc.



ELECTRIC CABLES
over 60 types of electric wires and cables for every purpose.

TELEPHONE WIRE
bare galvanized, switchboard cable, twisted pair and parallel, etc.

DRAWN and ROLLED SHAPES
high or low carbon, for many uses including flexible shaft casings of dental equipment, miniature railroad tracks, etc.



Over 100 years ago John A. Roebling made America's first wire rope. Wire alone had been a useful but feeble servant of mankind. But, now, wire really went to work!

The first Roebling Wire Rope was used for hauling Pennsylvania Canal Boats up the Portage Railway. Then, came Roebling Cableways, installed in many countries to transport construction materials across streams and gorges—followed by the first suspension aqueduct for the old Pennsylvania Canal.

John A. Roebling's first wire rope has made possible many of our modern industrial and commercial achievements . . . great suspension bridges from coast to coast, from the "George Washington" between New York and New Jersey to the "Golden Gate" Suspension Bridge in San Francisco — high speed elevators for skyscrapers — oil well drilling — mechanized mining — modern highway building — and other accomplishments too numerous to mention.

Today, Roebling's "Forward March with Wire" encompasses not only wire rope but a great variety of other Roebling Wire Products including, in part, Electric Wires and Cables, Woven Wire Fabrics, Welding Wire, Cold Rolled Steel Flat Wire, and many others.

JOHN A. ROEBLING'S SONS COMPANY, TRENTON, N. J.
Branches in principal cities
Export Division: 19 Rector Street, New York, N.Y., U.S.A. Cable Address: "Roebling's" New York

CH WITH WIRE

1941

WELDING WIRE . . . ROUND AND SHAPED WIRE . . . WIRE FORMS
WIRE CLOTH AND NETTING . . . STEEL AND COPPER RODS
HIGH AND LOW CARBON ACID AND BASIC OPEN HEARTH STEELS

Bring the Job Through
AHEAD OF SCHEDULE

LINK-BELT SPEEDER

"300" SERIES
1½-2 CU. YD.
CAPACITY
SHOVEL-DRAGLINE-CRANE

Close figuring on today's jobs demands greater output from man and machine, and low maintenance costs. The new speed,stamina, balance, stability and power built into Link-Belt Speeder "300" Series machines are enabling contractors to secure 25% greater output at lower operating costs. The exclusive feature that gives output the big boost is effortless, accurate Speed-o-Matic Hydraulic control. By eliminating operator fatigue, the greater speed and capacity for work built into the "300" Series machines are maintained throughout the entire shift. Speed-o-Matic control alone makes big slashes in maintenance costs because it eliminates 152 working parts that are essential to lever-operated controls. Link-Belt Speeder machines range in size from ⅜ to 3 yard . . . crawler, truck and tractor mounted. Get the facts from your nearest dealer.

Speed-o-Matic

8404

- ★ Interchangeable Crawler Side Frames with Patented Tread Design
- ★ Rigid Drive End Bearings and Independent Take-Up Means for Crawler Treads and Drive Chains
- ★ Welded, Stress-Relieved Construction of Main Units
- ★ Exceptional Unobstructed Ground Clearance
- ★ Propelling and Steering Mechanism Fully Contained and Enclosed Within Lower Frame
- ★ Self-Aligning Center Pin Bearing and Self-Aligning Rotating Rollers
- ★ Anti-Friction Bearings and Splined Shafts
- ★ Speed-o-Matic Hydraulic Power Control

LINK-BELT SPEEDER CORPORATION

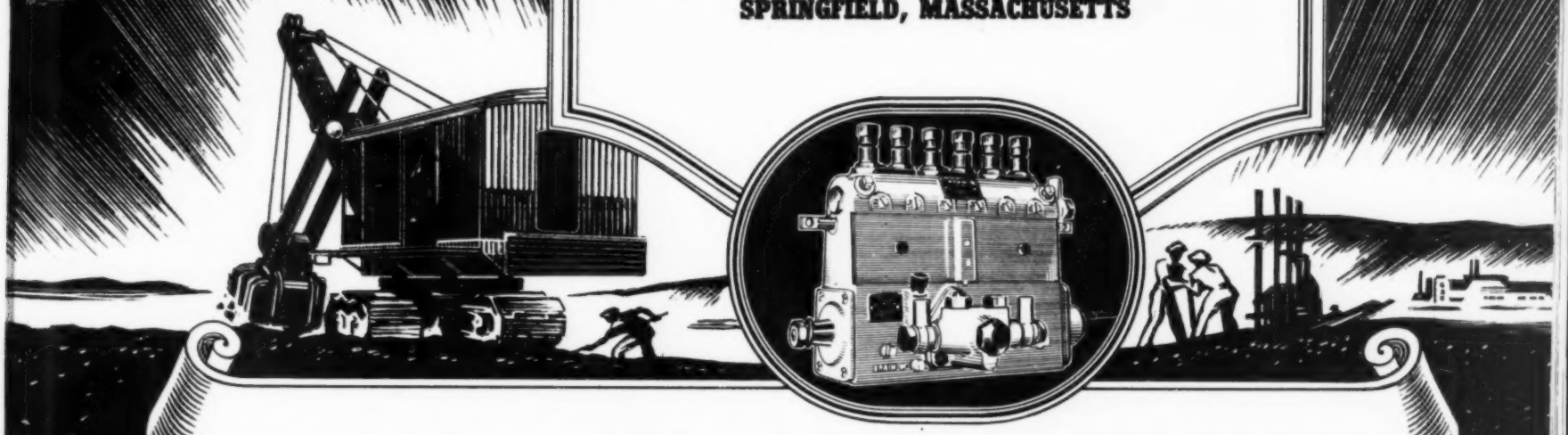
Builders of the Most Complete Line of Shovels and Cranes

301 WEST PERSHING ROAD • CHICAGO, ILLINOIS

NATURALLY it is a satisfaction to be recognized as the leader..or the largest..or the liveliest in any field..as American Bosch is regarded in the realm of Diesel Fuel Injection Equipment.

But the deeper, more gratifying achievement is to earn the reputation, as American Bosch has earned it, for friendliness; unselfish cooperation; bulwark-like dependability.

AMERICAN BOSCH CORPORATION
SPRINGFIELD, MASSACHUSETTS



AMERICAN BOSCH
Fuel Injection STANDARD OF AMERICA WORLD WIDE SERVICE *Equipment*

DETROIT PUBLIC LIBRARY

THE

FIRST 10

"CATERPILLAR" DIESEL TRACTORS

...and they're still going strong!

You can expect long-term, economical service from a "Caterpillar" Diesel Tractor. These first ten tell you that! Yet what they have to tell you is *only the beginning.* Because, as dependable and serviceable as these machines have been, today's "Caterpillar" Diesel Tractors are even more so!

These are not only the first Diesel tractors built by "Caterpillar"— but the *first* practical Diesel track-type tractors *ever* constructed. Each now has thousands of hours of hard work behind it . . . *and is still putting out low-cost power!* Here is evidence that the basic "Caterpillar" design and construction were *right* from the start. And while they are basically unchanged, they have been improved through these ten years of experience!

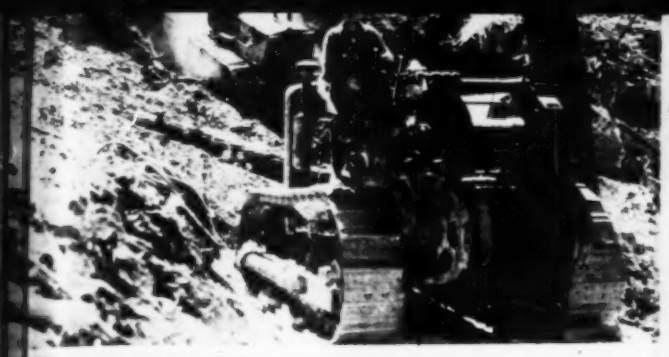
Today, for example, you get "Hi-Electro" hardening of the track roller-rims and shafts, track-pins, cylinder-liners, crankshaft, and such parts that must fight the most wear. And today's "Caterpillar" Diesel Engine gives you *more than ordinary Diesel economy* — through its ability to operate efficiently on low-grade, non-premium fuel!

As a power-user, you owe it to yourself to know more about these first ten "Caterpillar" Diesel Tractors and others of the *tens of thousands* that have come after them. Write *today* for a FREE copy of the 30-page book entitled "1,000,000 Hours of Diesel Satisfaction."

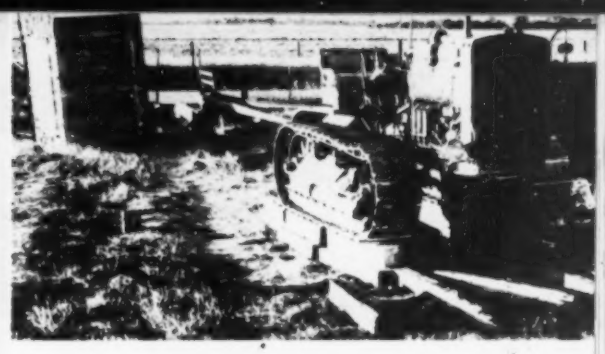
CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS

CATERP

ENGINES AND ELECTRIC SETS



No. 1. After nine years of the heaviest kind of jobs—contracting and logging—this "Caterpillar" Diesel Tractor is still turning in a full day's work on the lumbering operation of Howell & Howell, Quincy, California.



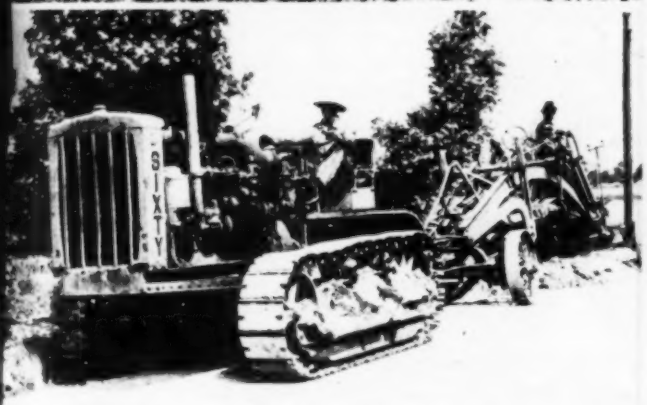
No. 2. In 7000 hours of operation, this "Caterpillar" Diesel saved W. C. Schuder & Son, Woodland, California, $3750 on fuel! Still on active duty—pulling such heavy loads as three 5-bottom 12-inch plows.

No. 3. Some of the world's heaviest pulling is found in the sugar-cane fields. This "Caterpillar" Diesel Tractor has had 18,683 hours of it—and is still good for many thousands more, according to the Oahu Sugar Co., Waipahu, Oahu, Territory of Hawaii.

No. 4. The engine was removed from the No. 4 "Caterpillar" Diesel to power this washing machine on a gold-and-gravel operation near Caledonia, Virginia. Runs 10 hours a day on 3½ gallons of fuel an hour. Has operated a total of more than 30,000 hours!

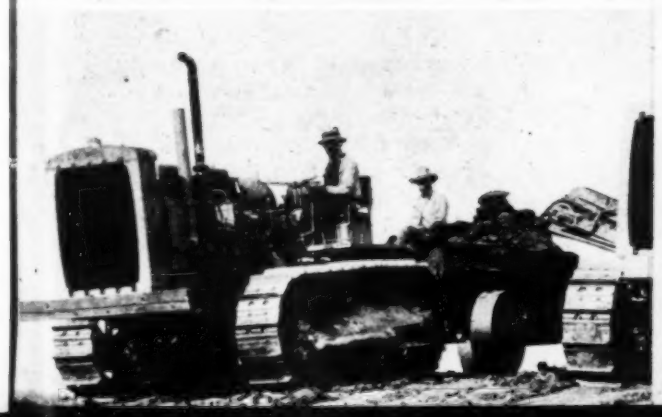
No. 5. Started out on the Mississippi levees for Harry Rodgers, Colfax, Louisiana. Engine later turned into a power-unit and has driven two cotton-gins and a lumber-planing mill. Now powering a drag-line. Estimated operation: 35,000 hours!

No. 6. The details on this machine are included with those of No. 10 below.

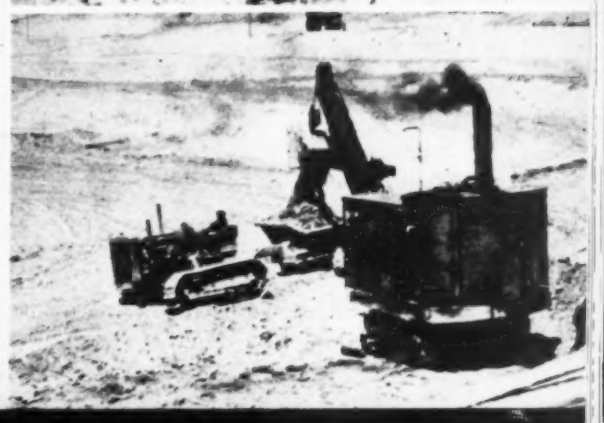


No. 7. More than 16,640 hours behind this seventh "Caterpillar" Diesel which went to work in December, 1931. Has probably spent most of its life to date on road-building and maintenance. Still at work for its original owner: Georgia State Highway Department.

No. 8. The details on this machine are included with those of No. 10 below.



No. 9. After five continuous years of construction work, starting in 1932, this machine was put on a lease basis for farming and construction. Still on the job! No record of its thousands of hours of operation. Owned by E. C. Hale, of Circle, Montana.



No. 10. This, and No. 6 and No. 8, formed part of a fleet of twenty purchased by Dumon & Vandervin, of Belgium, in 1931. They helped build the Albert Canal and were still in service as late as March 30, 1940. War conditions in Europe prevent obtaining complete details of their work-record.

PILLAR DIESEL

TS TRACK-TYPE TRACTORS • ROAD MACHINERY

2
KINDS OF WIRE GIVE *EXTRA* STAMINA TO MONARCH *PRE*FORMED

"THESE EXTRA-TOUGH INNER WIRES—
inside every strand are improved plow steel. They are unusually pliable and are designed to fight internal fatigue caused by continuous bending. These flexible and tough wires provide the reserve strength of the rope."

"THESE EXTRA-TOUGH OUTER WIRES—
in every Monarch Whyte Strand Rope are also improved plow steel specially drawn for outside service. They are made to take the worst punishment wire ropes can be subjected to—they resist corrosion, dragging, jerking, abuse and abrasion."

AROUND BOTH WIRES AND STRANDS is a specially formulated Macwhyte internal lubricant. It protects the unseen, inside wires against damaging and costly internal friction. Ask your Macwhyte distributor about Monarch Whyte Strand PREformed. Field proved on equipment like yours, it's the CORRECT rope for your job.

PENNSYLVANIA'S FAMED TURNPIKE, now history, gave Monarch Whyte Strand PREformed many opportunities to prove again it's a "tough" rope to beat. Strong, flexible, long lasting, it lowered contractors' costs, reduced shutdowns to minimum.

NO. 5134

MACWHYTE COMPANY
2941 Fourteenth Avenue, Kenosha, Wisconsin

Manufacturers of Rope Wire, Braided Wire Rope Slings—Monel Metal and Stainless Steel Wire Rope—Aircraft Cable—"Safe-Lock" Cable Terminals—Aircraft Tie Rods—and Wire Ropes for all requirements. New York · Chicago · Pittsburgh Ft. Worth · Portland · Seattle · San Francisco. Distributors throughout the U. S. A.

MACWHYTE EXCAVATOR ROPES

TESTED INTERNALLY LUBRICATED PROVED

The correct ropes for your equipment

PRE-FORMED FOR BEST PERFORMANCE

SPRING ROAD DESTRUCTION IS COMING!

Be Ready with BUCKEYE SPREADERS *to repair the damage!*

WHERE spring rains come or where a winter's covering of ice and snow thaws and the roads become ruts, you've got to be ready to put them in shape quickly and economically.

For this job, there's no machine to beat the Buckeye Spreader for putting down chips sand or even No. 1 rock. Buckeye Spreaders have a transmission-driven spirally fluted feed roll that puts the material down uniformly and in accurate volume. County highway departments and contractors give these reports on Buckeye Spreaders: 98%-99% accuracy . . . labor saving of 50% and more...savings in material as high as 20%...saves time and money . . . spreads close to roadside obstructions . . . saves raking and brooming.

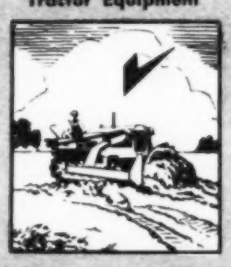
Add up these advantages and you'll see that it will pay you well to investigate the Buckeye Spreader. Write today for 8 page Bulletin.

BUCKEYE TRACTION DITCHER COMPANY
FINDLAY, OHIO

Built by Buckeye

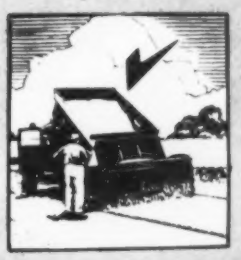
Convertible Shovels

Trenchers


Tractor Equipment

R-B Finegraders

Road Wideners


Spreaders

LaPLANT-CHOATE
Forced Ejection Type
CARRIMOR SCRAPERS

Are 33 Yd. Scrapers *Too Big?*

LaPlant-Choate Carrimor Forced Ejection Type Scrapers are available with cable control in four sizes — 12 yd. to 33 yd. capacity. They give you a lower cost for hauling.

Because the big 33 yd. Carrimors could haul larger, well filled loads, they cut hauling costs and speeded up the job.

for Bigger Loads . . . . . Fewer Trips . . . . Lower Hauling Cost·

No! Say- Marsch, Peterson & Walker

• Actual Test Made On the Job Proves Big Scraper Superior in Performance

They loaded well-heaped loads of sticky gumbo. Each one foot of heap on this scraper adds 5 yds. to struck measure load.

You can't beat an "on the job" test to prove your point . . . and our point is that LaPlant-Choate Carrimor Scrapers — regardless of size — pay you better returns in performance and profits!

Take the case of Marsch, Peterson and Walker — They were told that 20 yd. scrapers were needed for their flood control job at Lawrenceburg, Indiana. "Anything larger than 20 yd. scrapers can't top out levees 35 feet high and can't negotiate the grades!" These successful contractors decided to make tests before selecting size and make of scrapers.

THE TEST PROVED . . . that a fully loaded 33 yd. LaPlant-Choate Scraper could be pulled up a 14% grade with a "Caterpillar" D-8 Tractor . . . that they turned around in practically the same distance as competitive 20 yd. scrapers . . . that the Carrimor made trip for trip with the 20 yd. scraper, taking a few seconds longer to load but dumping faster in very sticky gumbo.

THE RESULT . . . Marsch, Peterson and Walker bought *three* LaPlant-Choate 33 yd. scrapers and *one* 19 yd. LaPlant-Choate Scraper. One week later they bought another LaPlant-Choate 19 yd. Scraper. Seven weeks later they purchased *four more* LaPlant-Choate 33 yd. Scrapers . . . a total of *seven* 33 yd. and *two* 19 yd. scrapers. They were assured of 269 yards of material on every round trip of the fleet.

Did their investment pay? Marsch, Peterson and Walker started this 2,800,000 yard job in July, 1940 with December, 1941, as the time limit for finishing. *They finished the job in December, 1940 — one year ahead of time limit.*

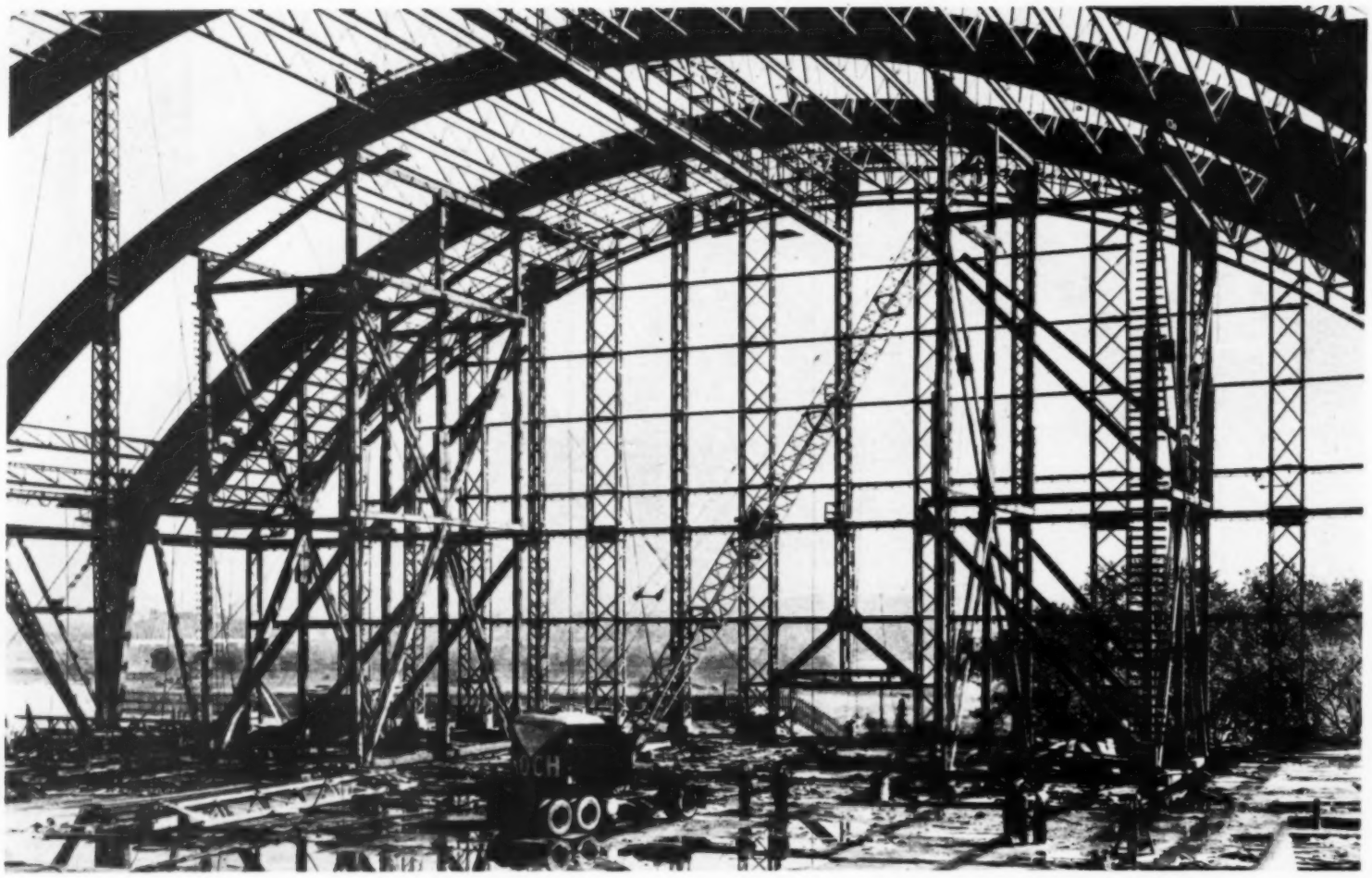
These big scrapers dumped larger loads of the stickiest material quickly and easily. Dumped on outer edge of fill safely.

After dumping, the big Carrimors come off levee down steep grades without jack-knifing or tipping.

• When the haul gets longer your costs go up unless you can haul larger loads at the same speed. Equip yourself with LaPlant-Choate Carrimors to save time, money and effort. Write or wire today for full details.

LA PLANT-CHOATE MANUFACTURING CO. Inc.

CEDAR RAPIDS, IOWA.



GENERAL

Supercrane with 100 foot boom, speeds construction on new Washington, D.C. Armory. Karl Koch Contracting Co. handled the steel erection.

IF YOU COULD REACH 100 FEET

you would have no better control than that given by GENERAL'S Precision Control.

Boom up or down—with or without load—fast or slow—many feet, or an inch at a time.

It's on the GENERAL SUPERCRANE—the sensational, new, pneumatic tired, one-man-one-engine operated crane. Write for new catalog.

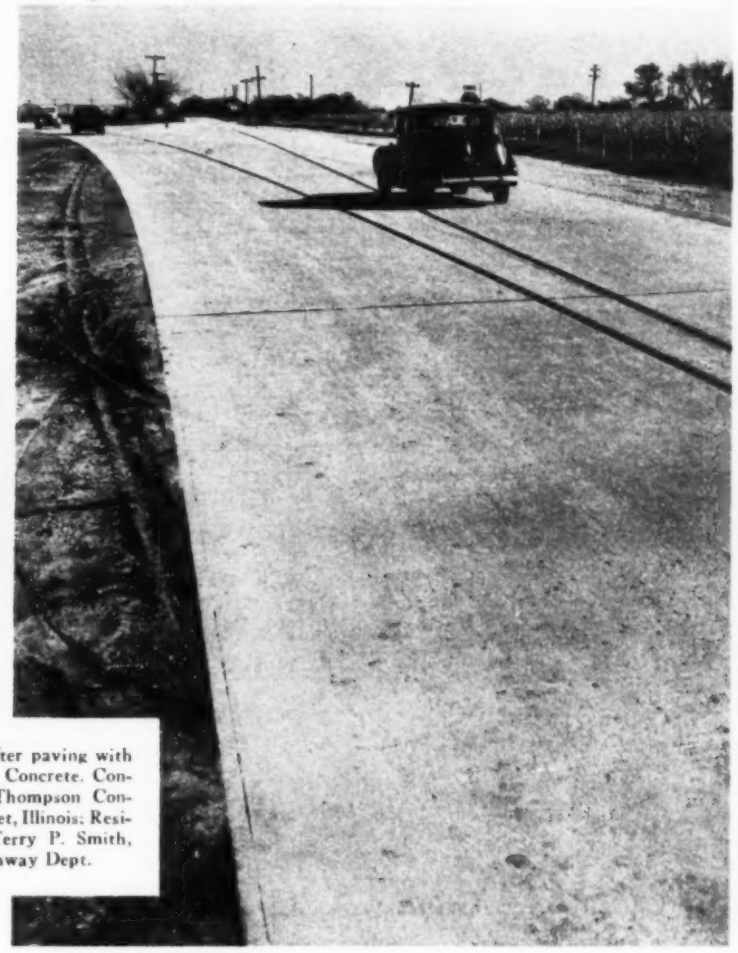
The OSGOOD COMPANY
Sizes: ½ to 2½ Cu. Yd.
Diesel - Oil - Gas - Electric
Associated with
The GENERAL EXCAVATOR CO.

The HERCULES COMPANY
HERCULES *IRONEROLLERS*
6 to 12 Tons
Diesel or Gasoline
Associated with
The GENERAL EXCAVATOR CO.

GENERAL
OSGOOD MARION OHIO U.S.A. GENERAL HERCULES
Sizes:
⅜-½-⅝-¾ Cu. Yd.
Diesel—Gas—Electric
SHOVELS
DRAGLINES - CRANES
Crawler & Wheel Mounted
THE GENERAL EXCAVATOR COMPANY, Marion, Ohio

CASE #31

On the job with Atlas High-Early Cement . . .



● During and after paving with Atlas High-Early Concrete. Contractor: Powers-Thompson Construction Co., Joliet, Illinois; Resident Engineer: Terry P. Smith, Illinois State Highway Dept.

REWARDED FOR SPEEDING ON A BUSY ROAD!

THE Illinois State Highway Department planned to connect two important state traffic routes with a new stretch of highway and a bridge.

PROBLEM: How to finish the existing gap in the shortest possible time; how to restore normal traffic flow on the highway quickly; and how to reduce maintenance of a 1,100-ft. detour.

THE ANSWER was simple. The Highway Department specified use of high-early-strength-cement — and the contractor selected Atlas High-Early cement.

RESULT: The gap was opened to traffic with a minimum of delay. Days were saved in completing the job. There also was a reduction in costs for protection and curing. Costs for maintaining the 1,100-ft. detour also were reduced because pavement was opened to traffic much sooner.

Engineers and contractors know they can depend upon Atlas High-Early cement to save them time and money. This cement gains working strength rapidly; cuts time for protection and curing as much as 60-70%; produces serviceable concrete in much less than the usual time; and often reduces form costs by permitting earlier stripping and reuse of forms.

Send today for interesting folder, "Case Histories of Days and Dollars," which tells how Atlas High-Early saved time and money on many jobs. Universal Atlas Cement Co. (United States Steel Corporation Subsidiary), Chrysler Building, New York City.

Offices: *New York, Chicago, Philadelphia, Boston, Albany, Pittsburgh, Cleveland, Minneapolis, Duluth, St. Louis, Kansas City, Des Moines, Birmingham, Waco.*

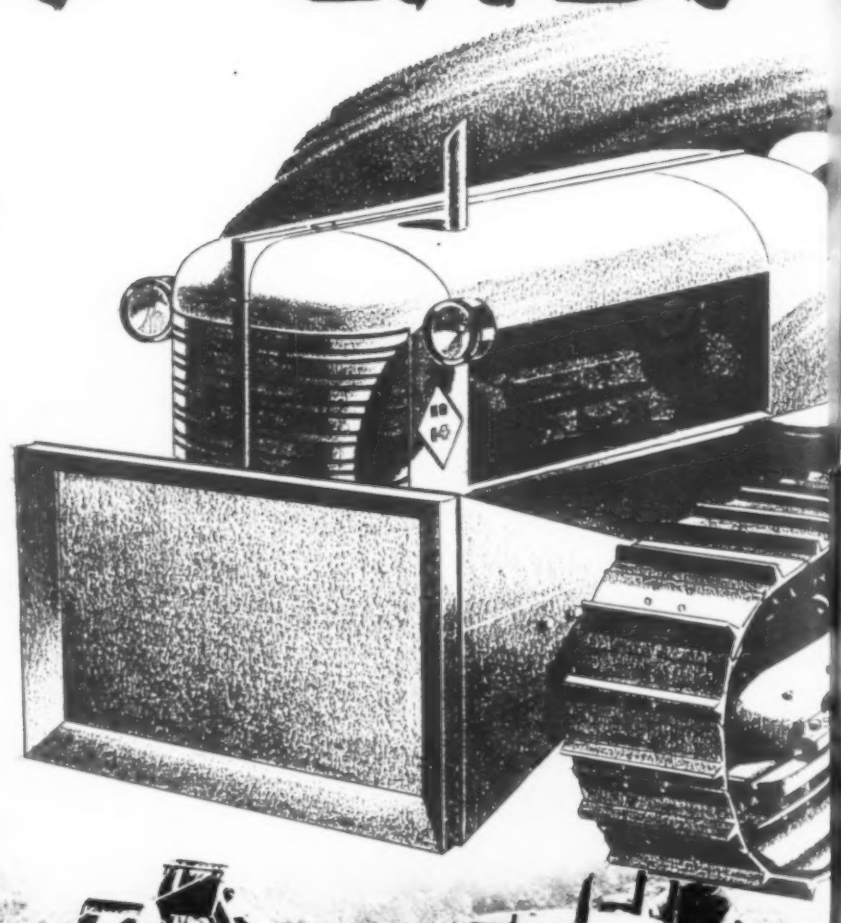
CM-H-26

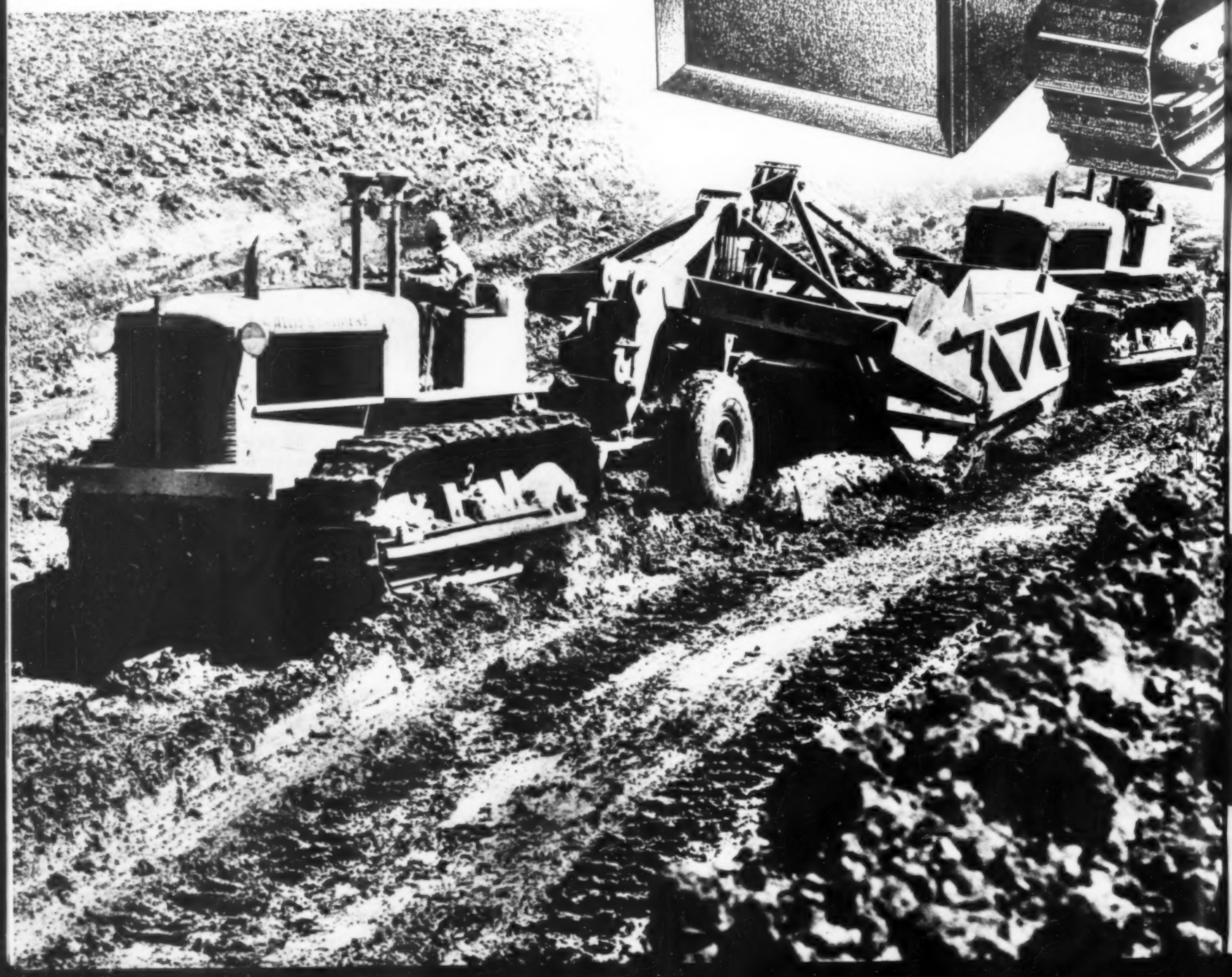
ATLAS HIGH-EARLY CEMENT

A UNIVERSAL ATLAS PRODUCT

WAKE UP "LAZY

PUT MORE ZIP BEHIND THE BOWL WITH HD-14 PUSHERS





LOADING"

Push your scrapers without shifting gears. You "gun" it and go with 2-cycle Diesel Power! Like "steam power"—operator keeps one hand on the throttle ... feeds fuel as he pushes. Saves valuable seconds—loads more scrapers every hour. Does it smoother—saves on repair bills. Clicks every second—displays razzle-dazzle maneuvering, in turning and traveling in high, in quickly getting into position for every load.

This same power on the front of your Gar Wood scraper assures bigger loads ... more trips every hour ... longer profitable haul distances.

Put an extra shot of life into your dirt-moving. Let your Allis-Chalmers dealer prove you can do it.

ALLIS-CHALMERS

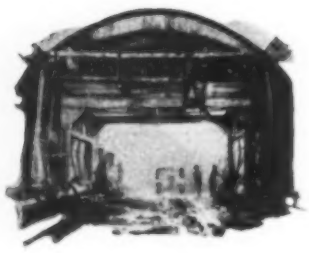
TRACTOR DIVISION — MILWAUKEE, U.S.A.

2-CYCLE DIESEL POWER

THREE SIZES
HD- 7, 54 H.P.
HD-10, 79 H.P.
HD-14, 108 H.P.

Ralph Aldridge, Council Grove, Kansas, speeds up his Canning Creek Dam project with a fleet of HD-14's—several shown here with Gar Wood Cable Controlled Scrapers.

. . . "to avoid paying a penalty of $500 per day"



TUSCARORA MT. TUNNEL
of the Pennsylvania Turnpike
CONTRACTOR: B. Perini & Sons, Inc.
Framingham, Mass.

There's more than excitement in a contractor's race against time; there's a money loss if he loses. How a race is won is interesting—and profitable—news.

Let Supt. George Phillips of B. Perini & Sons report in his own words his experience with Lehigh Early Strength Cement:

"The ceiling concrete for the Tuscarora Mt. tunnel required 1600 lb. strength before forms could be stripped. By using Lehigh High Early Cement we were able to strip the forms in 10 hours, thereby giving us a pour every day. Our working cycle included pouring sidewalks, arch and ceiling every day, and without the use of high early cement in the ceiling this part of the cycle would have lagged way behind unless additional forms were purchased. The completion of this tunnel project was imperative to avoid paying a penalty of $500 per day. By using high early cement we were able to keep down our cost of forms, excess penalty and cost of overhead."

Lehigh Early Strength Cement reaches service strength three to five times faster than normal Portland cement. Besides providing the emergency advantages that were vital to the Tuscarora Mt. tunnel project, this quick strength brings added advantages to the road builder. Equipment and materials can often be moved over the new concrete in 24 to 48 hours; intersections can be opened quickly, eliminating the nuisance and expense of detours; forms can quickly be removed and reused; and the entire job expedited, thus reducing overhead. A Lehigh Engineer will gladly answer inquiries.

Lehigh

EARLY STRENGTH CEMENT

for safe concrete in a hurry!

LEHIGH PORTLAND CEMENT COMPANY · ALLENTOWN, PA., CHICAGO, ILL., SPOKANE, WASH.

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The change made to bring this about was the adoption of *Texaco 303 Motor Oil.*

Texaco 303 Motor Oil assures freedom from sludge and carbon deposits over longer periods of time.

The outstanding performance that has made Texaco preferred in this field has also made it preferred in the fields listed in the panel. These buyers are enjoying many benefits. You, too, will find important advantages when you use Texaco Lubricants and Fuels. A Texaco Lubrication Engineer will gladly cooperate in making savings in *your* plant. Phone the nearest of more than 2,300 Texaco distributing plants in the 48 States, or write:

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every Saturday afternoon, NBC. See local newspaper for time and station.

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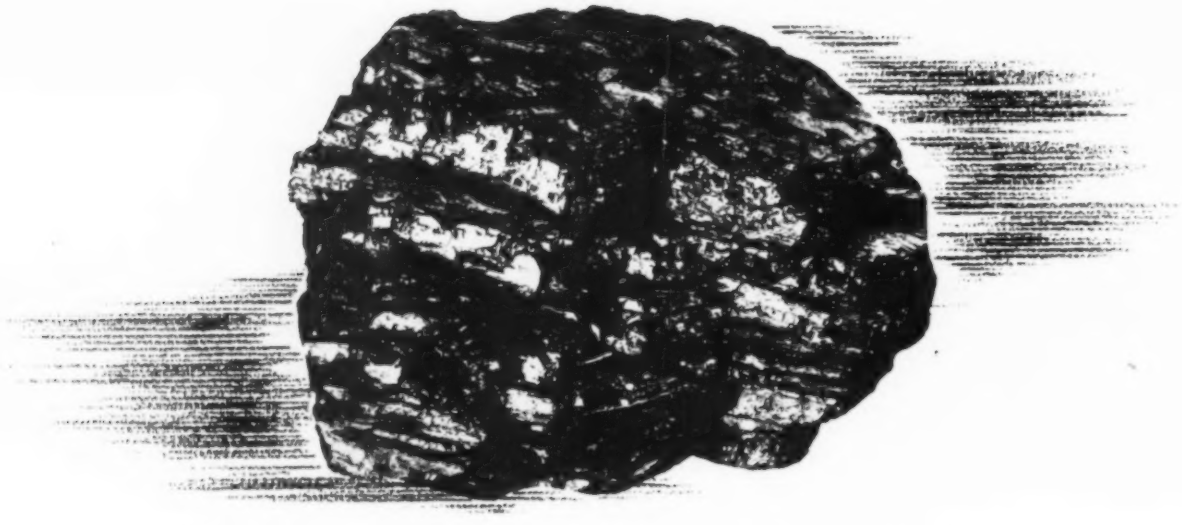
FOR ALL CONTRACTORS' EQUIPMENT



In these days—would you try a coal with 75% more B.T.U.'s?*

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Extreme resistance to fatigue (which means longer life for wire rope) is an inbuilt quality in LAY-SET. The preforming process, through which it is passed at the mill in Wilkes-Barre, sees to that. But not only does preforming make Hazard LAY-SET give much longer service, but it makes it resist kinking, makes it handle easier and faster, makes it safer for workmen to handle. And there you have the basic essentials of speed, economy and safety.

For longer rope life, fewer machine shutdowns, increased production, reduced injuries to workmen—specify Hazard LAY-SET Preformed Wire Rope. All Hazard ropes identified by the Green Strand are made of Improved Plow Steel.

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Gar Wood Road Machinery is preferred because it excels all others in doing the work best and at lowest cost, according to users' records of results.

4-WHEEL CABLE-OPERATED, earth-moving **SCRAPERS** dig, load, dump and spread. Capacities 15, 20 and 25 cubic yards. Send for BULLETINS R186, R187 and R194. (Above) Gar Wood double-drum, cable-power CONTROL UNIT, designed and tested for 30 cubic yard loads (Send for BULLETIN R198.)

4-WHEEL HYDRAULICALLY OPERATED, earth moving **SCRAPERS.** Outstanding for fast operation. Capacities 8, 10, 12, 15 and 20 cubic yards. Send for BULLETINS R163, R164, R165, R167 and R195.

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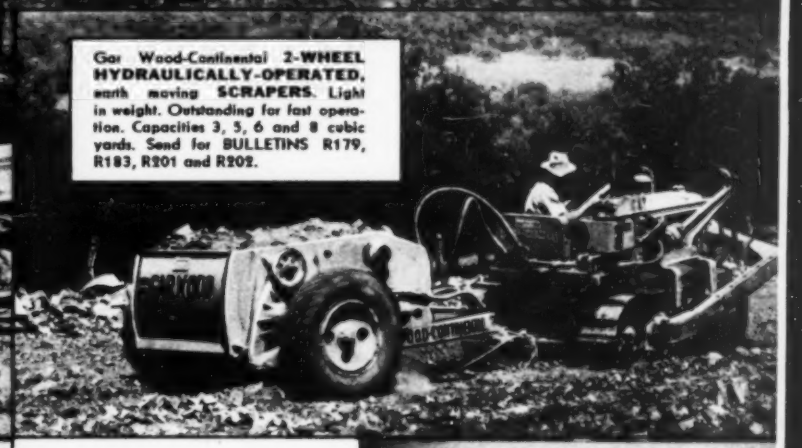
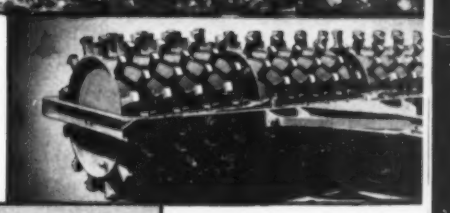
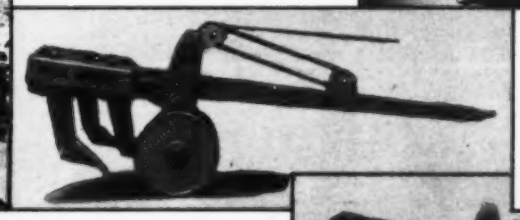


SHEEP-FOOT TAMPING ROLLERS pack fills. Available in single, double or triple units or tandem combinations. Send for BULLETIN R154. →

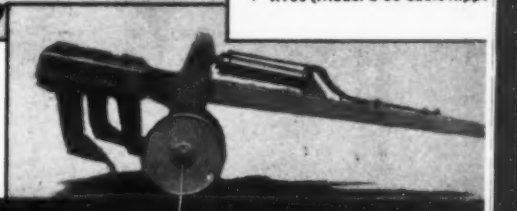




CABLE- AND HYDRAULICALLY-OPERATED RIPPERS for ripping compact earth, shale, rock, roots, old pavements and old roads. Send for BULLETIN R184 (Model H-Hydraulic Ripper) and BULLETIN R185 (Model C-80 Cable Ripper)

GAR WOOD ROADBUILDERS provide power up and down on blade which raises and lowers. Blade can be set for right- and left-side casting. Send for BULLETINS R203 and R205.

← **GAR WOOD BULLDOZERS** provide power up and power down on blade with quick control to regulate cut. Send for BULLETINS R204 and R206.



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ROAD MACHINERY DIVISION

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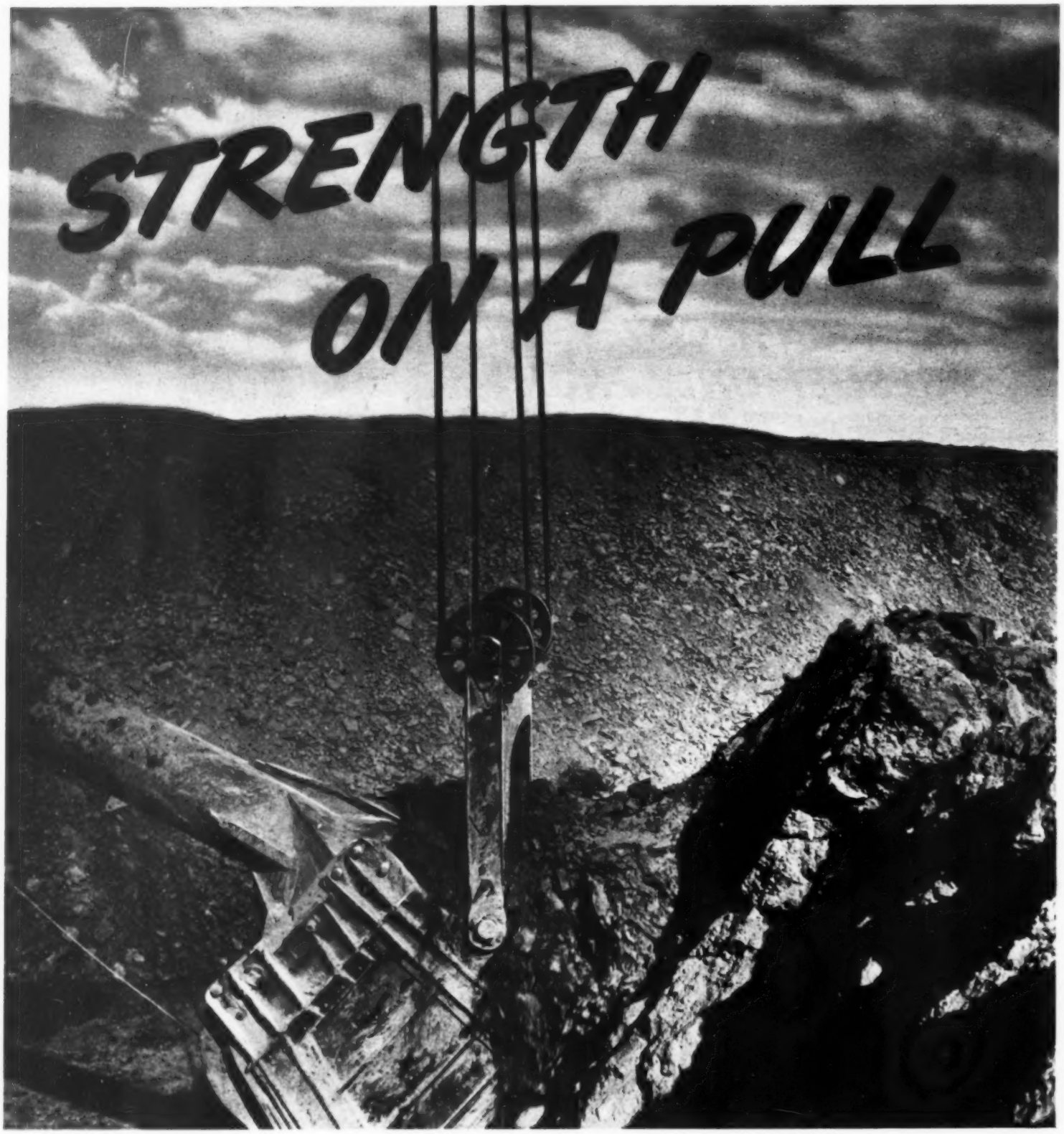


You've heard the engine on a power shovel chug and stutter down to the stalling point when the bucket bit into tough going and you've seen the hoist line go taut as a violin string over the sheaves.

That's what we mean by pulling.

Bethlehem Purple Strand is built for this kind of pulling. It's made 100 per cent of Improved Plow Steel, the strongest, toughest steel used in wire-rope manufacture. The core, the wires, the strands are each specially lubricated to protect Purple Strand against internal abrasion and rust. Every detail in the making of the rope—from ore to shipping reel—is carried out by the integrated teamwork of one organization.

When you buy Purple Strand Wire Rope you get lasting strength and toughness, rope after rope, year after year. Why not try it?

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

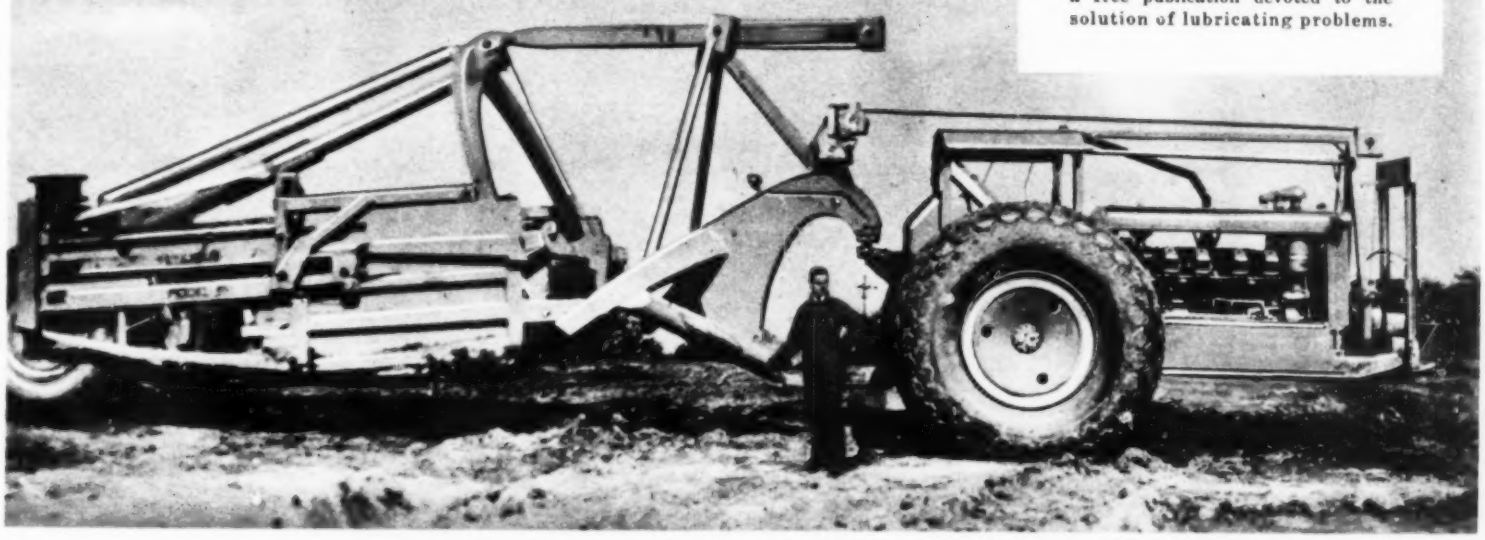
NATIONAL DEFENSE calls for more speed, more special construction, more road building. Equipment must not fail. Continuous operation with avoidance of breakdowns depends largely on correct lubrication. For *road construction* and *earth moving machinery* there are . . .

. . . SINCLAIR OILS AND GREASES that offer top efficiency while helping to keep operating and maintenance costs low. No matter what make or type of construction machinery you operate, Sinclair is prepared to serve you with the correct lubricant for maximum service and economy. For quick deliveries of Sinclair products, write the nearest Sinclair office or Sinclair Refining Company, 630 Fifth Avenue, New York.

* * *

(Left) Letourneau Model "A" **TOURNAPULL** *— owned by the Frank Mashuda Co., and operating in Pennsylvania. This operator's equipment is Sinclair-lubricated.*

Write for "The Service Factor"— a free publication devoted to the solution of lubricating problems.



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SINCLAIR REFINING COMPANY (Inc.)

2540 W. CERMAK RD. CHICAGO · 10 W. 51ST ST. NEW YORK · 1907 GRAND AVE. KANSAS CITY · 573 W. PEACHTREE ST. ATLANTA · FAIR BUILDING, FT. WORTH

Check these output-producing features against any 2½-yard excavator

1. Long upper boom section and big point sheaves give highly efficient digging angle.
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4. 207 H. P. diesel engine gives plenty of power for fast operation in tough digging.
5. Extensive use of anti-friction bearings and oil gear enclosures means sustained operation smoothness.
6. Every detail is scientifically designed for smooth performance and long life.

Investigate the 54-B carefully and you'll see why it will give you real performance in any kind of digging.

Bucyrus·Erie

SOUTH MILWAUKEE, WISCONSIN

Thor No. 23 Paving Breaker handles BOTH!

Handles Like a Lightweight . . . Wallops Like a Heavy!

That's why Thor's new No. 23 Paving Breaker can perform with equal ease a pavement job that demands sustained power *and* a wall opening that requires fast, continuous movement. Weighing but 59 pounds, this new Thor machine gets its *extra wallop* from a block type piston hammer whose new design greatly increases the foot pound blows. It gets its *handling ease* through trim, stripped-for-action design that eliminates every ounce of excess weight. These and other Thor structural features like the quick-change Latch Type Retainer . . . the cool, rubber-grip handle . . . and a new cylinder that gives full effect to every hammer blow . . . make the new No. 23 the "Breaker with the Extras". Extra Power! Extra Output! And Extra Profits for you on every job!

Thor

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Paving Breakers
Clay Diggers
Sump Pumps
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Please send me the new Thor Catalog No. 42 containing complete information on rock drills, paving breakers, clay diggers, sump pumps, and associated air tools.

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FIRST RULE FOR LOW TIRE COSTS:

Fit your tires to your JOB!/

MUD TIRE Goodyear Sure-Grip

ROCK TIRE Goodyear Pneumatic Lug

DIRT TIRE Goodyear All-Weather Earth Mover

TIRE operating costs can be considerably reduced, performance materially improved by using tires designed for the particular type of off-the-road surface you're working on—rock, mud or dirt. That's why Goodyear builds a special tire for each.

Rock hauls demand a tire armored against cutting and gouging—the Goodyear Pneumatic Lug. Its massive *close-spaced* driving lugs protect the carcass from sharp rocks—provide powerful two-way traction with equal driving ability forward or in reverse.

In mud you want a tread that will penetrate and grip—the Goodyear Sure-Grip. Its deep-tapered driving bars are *wide-spaced* to take a big enough "bite" to compact the mud and provide go-ahead traction.

For drawn vehicles on soft loose dirt you want sufficient flotation to keep the load from bogging down. Goodyear All-Weather Earth Mover tires are recommended because their extra-wide "footprint" and low pressure floats the load over soft dirt—because its *close-nested* diamond tread assures *free-rolling* yet prevents side slippage.

Best proof that Goodyear builds the best tires for every job is—"more tons are hauled on Goodyear truck tires than on any other kind!"

All-Weather—T.M. The Goodyear Tire & Rubber Company

THE GREATEST NAME IN RUBBER

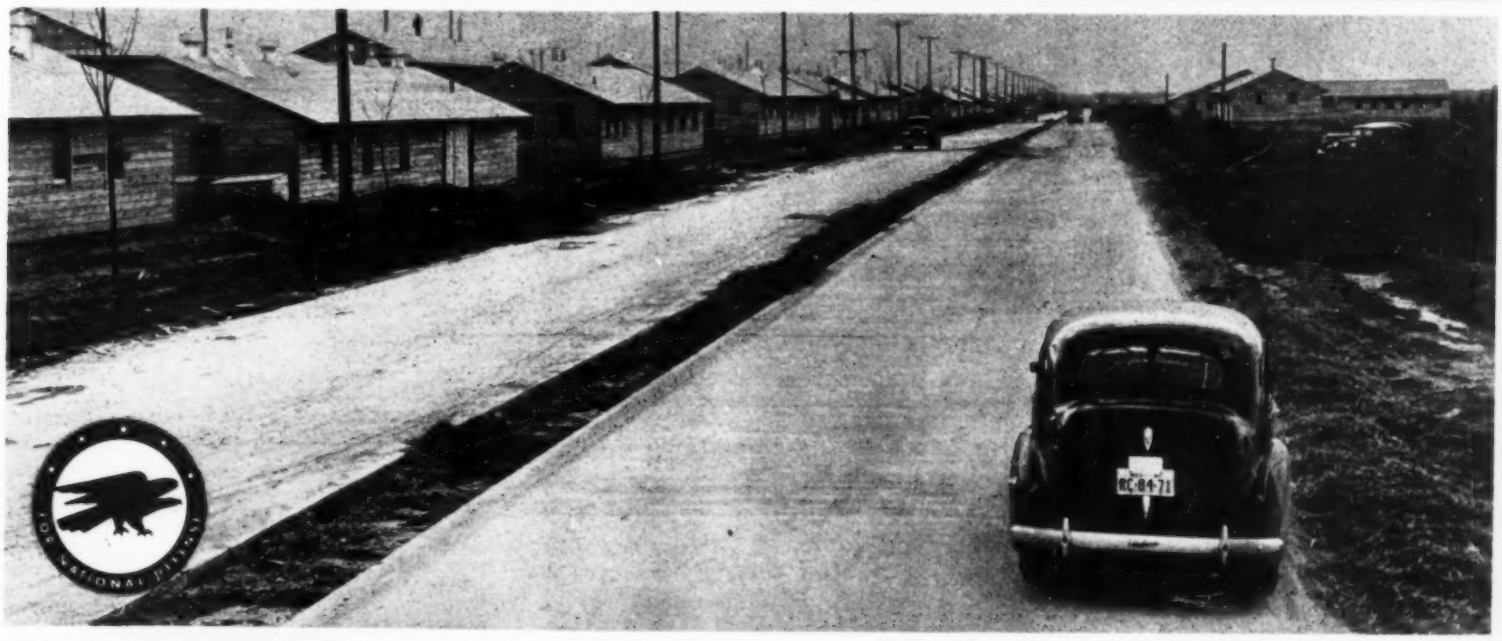
GOODYEAR

SPECIFY GOODYEAR RIMS, TOO—EASIEST TO APPLY AND REMOVE

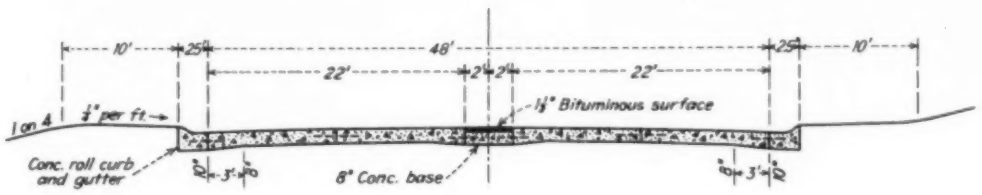
Construction Methods

ROBERT K. TOMLIN, Editor

Volume 23 | JANUARY, 1941 | Number 1



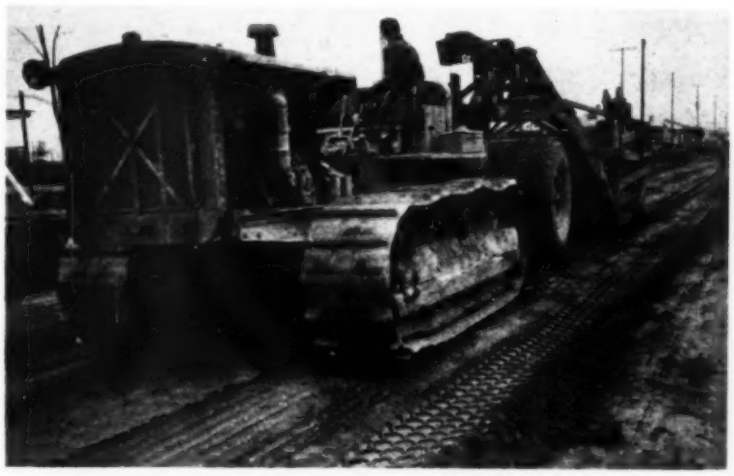
FIRST MILITARY HIGHWAY in United States is four-lane divided concrete pavement 2.337 mi. long built within area of Fort Custer, Mich.



CROSS-SECTION of 8-10-8-in. thickened edge four-lane concrete pavement, with 4-ft.-wide bituminous-surfaced dividing strip, at Fort Custer, Mich.

MICHIGAN BUILDS First Military Highway

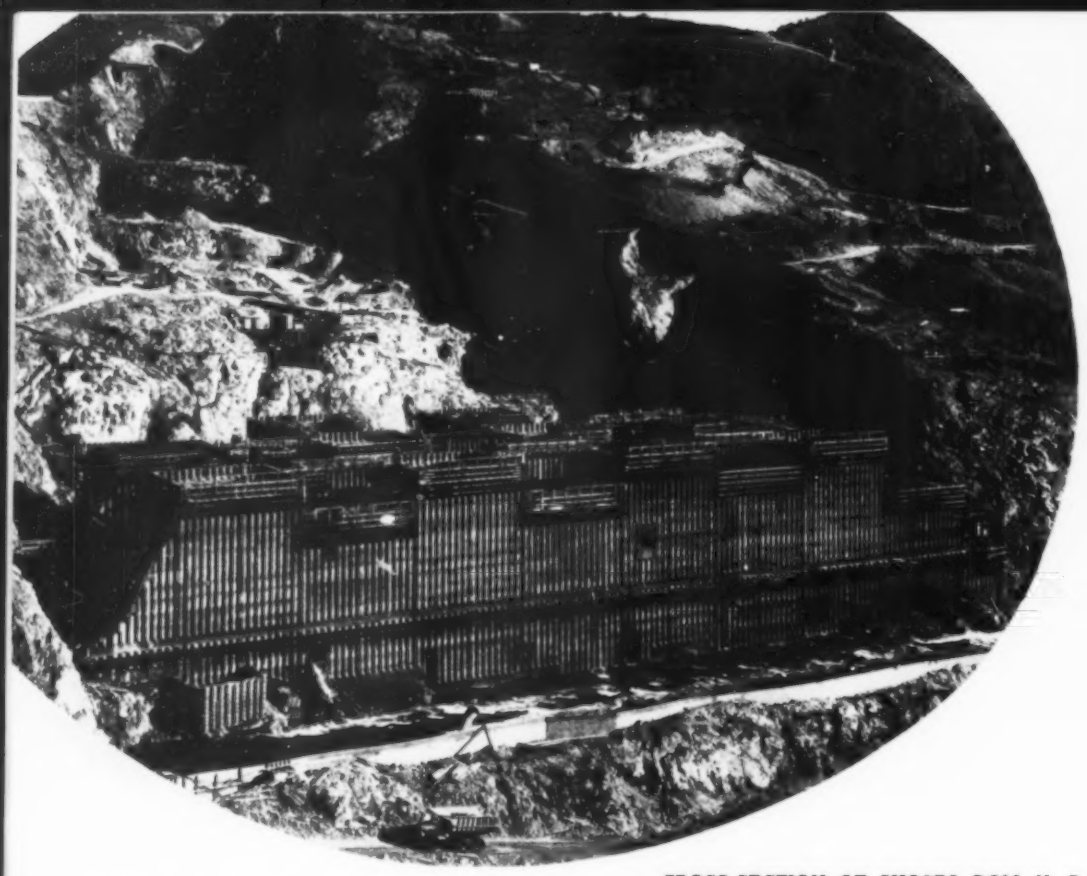
By G. DONALD KENNEDY
State Highway Commissioner of Michigan



GRADING of military highway is done with tractor-hauled scraper.

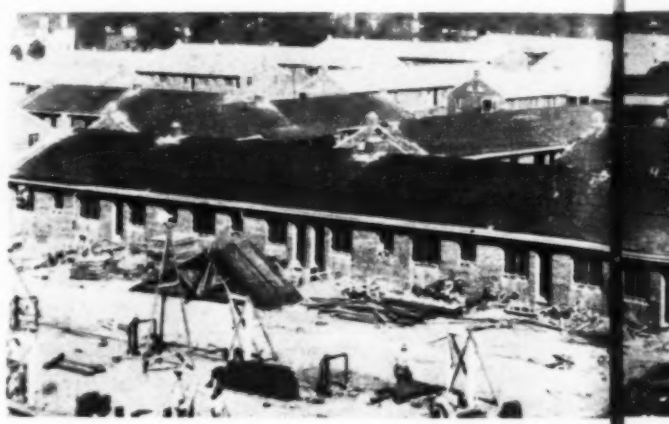
THE MICHIGAN STATE HIGHWAY DEPARTMENT has always taken an active interest in the national defense program. As a result of this cooperation we have been informed by the Public Roads Administration that we were the first state to start construction of a military road project in America. On the original site of Camp Custer at the westerly limits of Battle Creek the War Department has established a permanent army post known as Fort Custer. This fort will comprise approximately 16,000 acres and will house a number of units which include the Fifth Division of the Regular Army, the 184th Field Artillery of the National Guard and the 108th Observation Squadron of the Air Corps. When the fort is completed, upwards of 30,000 men will be located on the property. In other words, a complete new city is in the making and requires speedy construction of military highways.

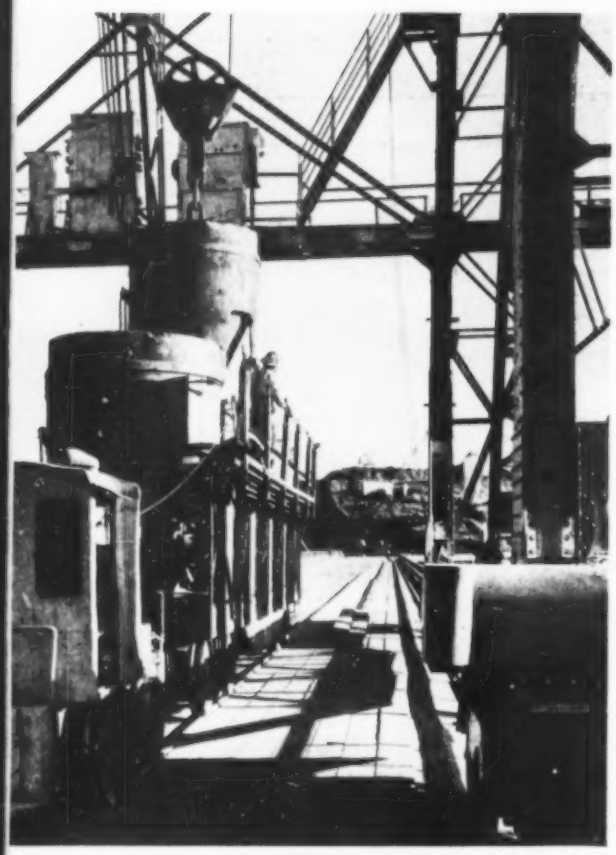
(Continued on page 96)



CROSS-SECTION OF SHASTA DAM. U. S. Bureau of Reclamation project in California, is indicated by this mass of concrete wedged into base of east abutment. Vertical grooves and ridges key together adjacent blocks of concrete. Base of structure to contain 6,000,000 cu.yd. of concrete, under construction by Pacific Constructors, Inc., measures more than 500 ft.

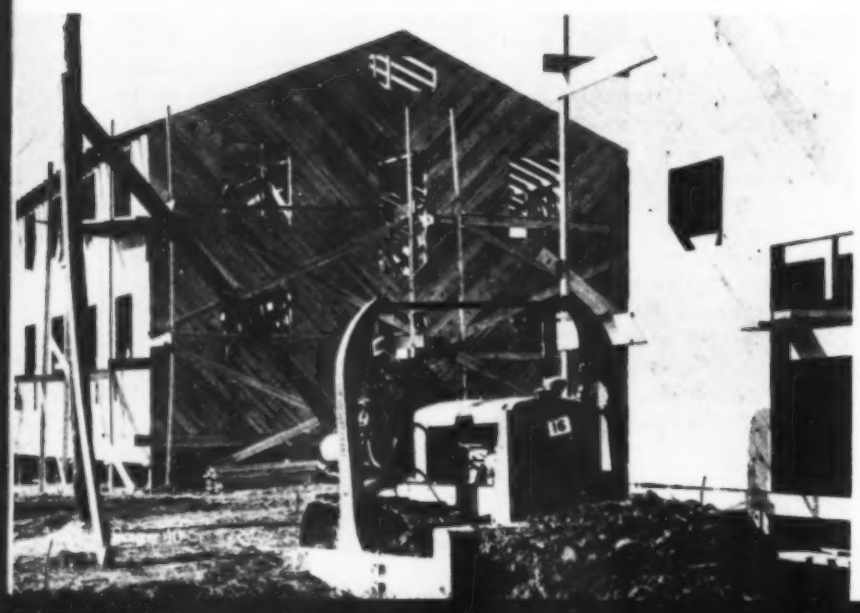
RAILROAD RELOCATION for Great Northern at approach to new bridge across Columbia River near Kettle Falls, Wash., involves movement of 400,000 cu.yd. of earth by C. E. O'Neal & Co., Inc., contractors, of Ellensburg, Wash. Caterpillar diesel tractors and Le Tourneau carryall scrapers work 21 hr. daily on 1,100-ft. haul.



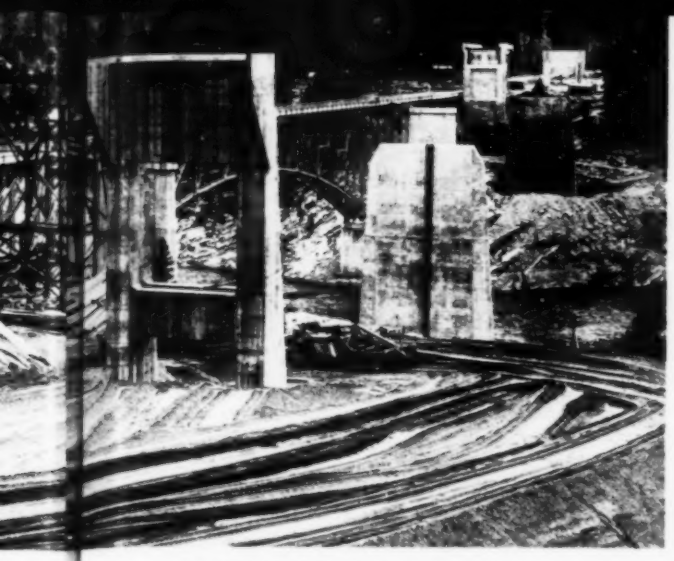


TRAINLOAD OF CONCRETE (left) is delivered from mixing plant via steel construction trestle for placement by overhead crane in Friant dam, U. S. Reclamation Bureau project in California. Seven trains each of five 4-cu. yd. buckets are hauled by 10-ton diesel-electric locomotives operated by Griffith Co. and Bent Co., contractors.

THIS MONTH'S NEWS REEL



ARMY BARRACKS CONSTRUCTION (left) is rushed at Camp Meade near Baltimore, Md. Using Allis-Chalmers tractor with Baker bulldozer, Potts & Callahan, contractors, grade site in preparation for erection of two-story structures of wood to house troops during military training period



DEFENSE HOUSING (below) takes form as construction advances on U. S. Housing Authority project of 424 living units to serve personnel at Maxwell Field, Army Air Corps base near Montgomery, Ala. Structures are mostly 4- and 6-family units designed for speedy construction. Design features include load-bearing tile foundation, steel casements rather than wood sash, asbestos-shingle roofs and exterior walls of unselected hard-burned brick.

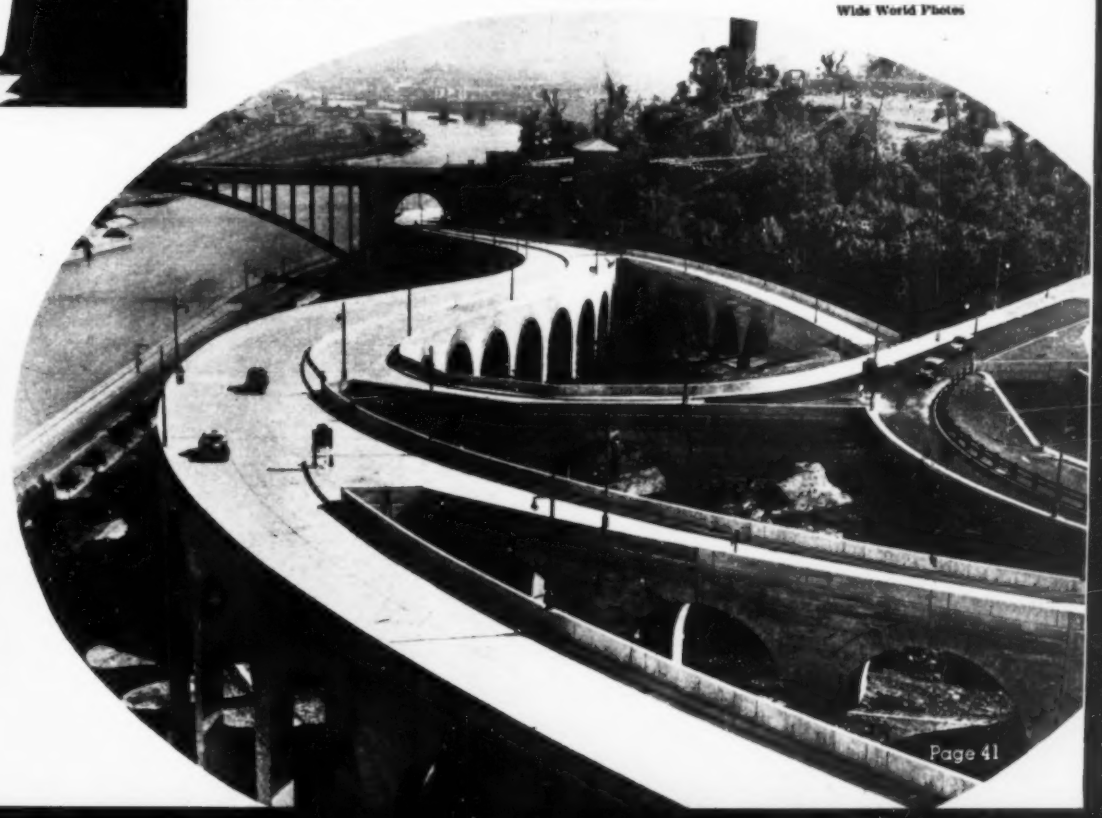
Army Air Corps Photo

THOMAS A. EDISON BRIDGE spanning Raritan River near Perth Amboy, N. J. is deck girder structure of 29 spans with total length, including approaches, of 4,385 ft. Largest girders weigh 200 tons, are 260 ft. long and 21 ft. deep. Designed by Morris A. Goodkind of New Jersey Highway Department to carry two 24-ft. roadways, bridge steel was fabricated and erected by Bethlehem Steel Co.

CONTINUATION OF HIGHWAY PROGRAM (below) was assured when WILLIAM B. BANKHEAD, (center) late speaker of U. S. House of Representatives, signed 1940 Federal Highway Act a few days before his death Sept. 15, 1940. CHARLES M. UPHAM (left) engineer-director of American Road Builders' Association congratulates Speaker Bankhead as his brother, Senator John H. Bankhead, of Alabama, looks on. New Hayden-Cartwright federal highway act authorizes $327,000,000 for highway construction in fiscal years 1942 and 1943.

TRAFFIC SEPARATION (below) on express highway approach to George Washington bridge, New York City, was solved by concrete arch structure involving steep grades and sharp curves. Unusual viaduct costing $1,000,000 was built by North-Eastern Construction Co. for Port of New York Authority, of which J. C. Evans is chief engineer.

Wide World Photos



ADEQUATE LIGHTING (below) for safe movement and direction of night traffic characterizes three-level intersection on New Jersey approach to Lincoln vehicular tunnel under Hudson River, New York. Refractor bowls on General Electric luminaires distribute light up and down traffic lanes, without waste of light into night sky.

Military Access Roads

To Army Camps, Naval Bases and Industrial Plants Are Nation's No. 1 Defense Highway Problem

A Statement Prepared for "Construction Methods" by the PUBLIC ROADS ADMINISTRATION, *Washington, D. C.*

Access-road requirements for military, naval and industrial establishments are urgent. They now rank first in priority, with the conditioning of the strategic national highway network second in importance. Defense needs call for 2,900 miles of access roads costing $194,000,000.

THE NATIONAL DEFENSE PROGRAM began taking shape only last fall. Already it shows up as the largest defense effort ever engaged in by this country. Road builders, manufacturers of road-building equipment and supplies, and others are wondering how it is affecting highway construction plans for 1941.

One immediate effect is a shift in the order of importance of road work that needs to be done. Last summer, the conditioning of the 75,000-mi. strategic system of highways seemed most urgent. Since then, Congress has enacted several laws in rapid succession, providing among other things for the mobilization of the National Guard, universal conscription of young men for military training and large appropriations for military equipment and supplies. This legislation for national defense sends hundreds of thousands of men and trains of motorized and mechanized equipment into Army and Navy reservations, many of which have been occupied only by skeleton forces or not at all for 20 years. It also brings new industrial plants into operation and encourages many existing industries to expand.

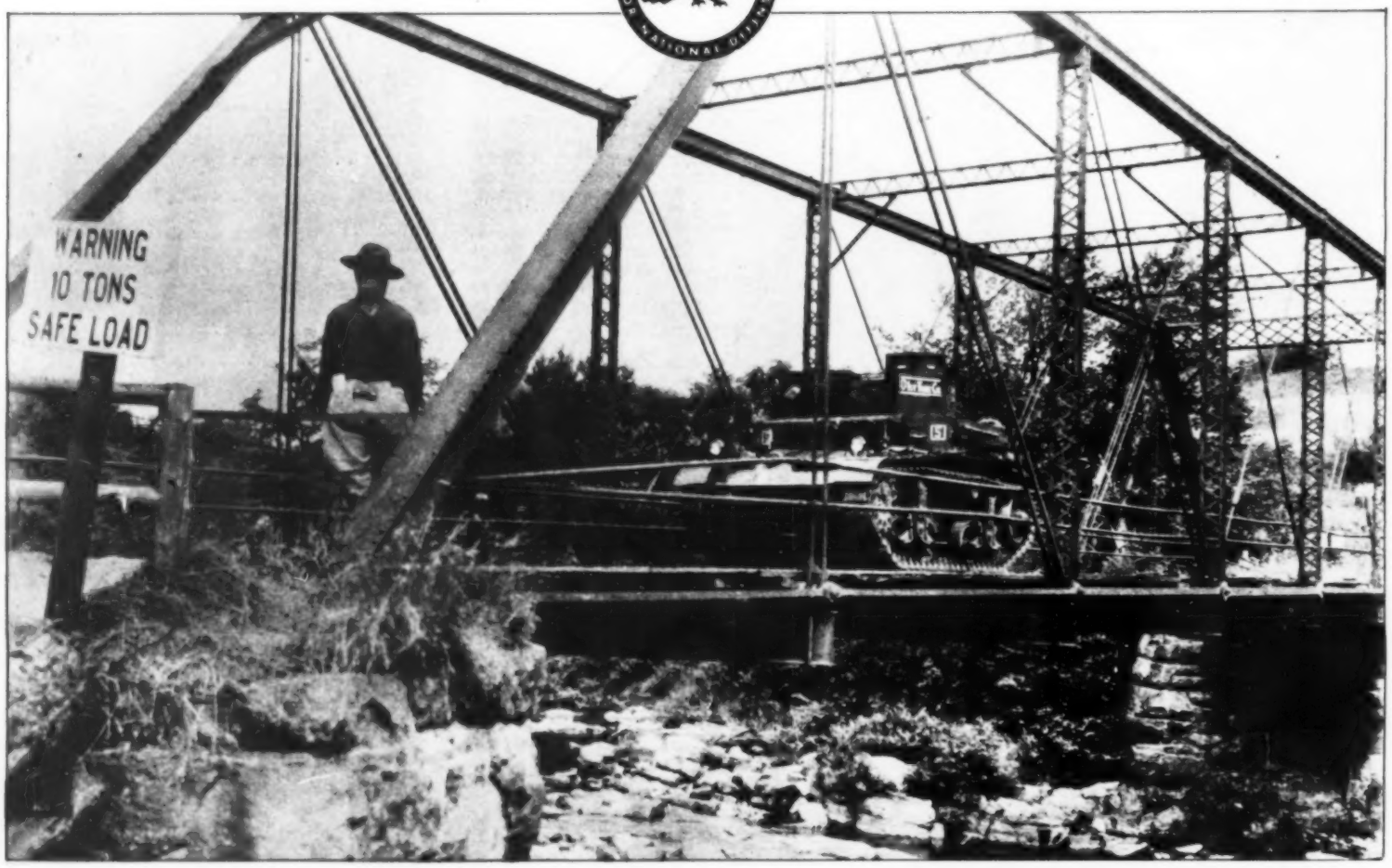
All this new activity requires many new roads and road improvements access roads for new military camps and new defense plants, and improvement of certain existing roads that will carry an additional burden of traffic growing out of the defense program. These road requirements are urgent. They now rank first in priority, with the conditioning of the strategic national network second in importance.

Needed Mileage Estimated

A preliminary estimate of the mileage of access roads needed for military and naval establishments alone shows a total of 2,900 mi. The cost of these improvements is estimated at $194,000,000. Most important additional mileage will be required for new defense plants. Estimated totals are not available on this program, since the location of only a few plants has been determined.

As for the money available for this rush job of access-road construction, it includes the regular federal-aid funds now apportioned to the states and not yet obligated for construction, totaling about $198,000,000 for the federal-aid system, about $38,000,000 for secondary or feeder roads, and about $68,000,000 for grade-crossing elimination. Under the federal-aid plan the highway funds

Photo U.S. Signal Corps



STRENGTHENING OF EXISTING BRIDGES to carry military loads is necessary. Here light army tank crosses weak bridge.

TRAFFIC PROBLEM on state highway is created by passage of mechanized cavalry column near Camp Beauregard, La.

are matched by state appropriations, but the grade-crossing funds are not.

Besides the federal-aid money already apportioned to the states, certain additional funds also are on hand for road work. These include:

(1) Funds authorized to be spent under the normal plan of operation of the Work Projects Administration, with the provision that not to exceed $25,000,000 of the total may be expended to pay for supervision, equipment and materials in excess of the amounts normally expended for such non-labor purposes, on roads certified by the appropriate defense agency as strategically important.

(2) Funds appropriated to the War

WIDE SHOULDERS on existing highways are desirable for parking of military trains.

AT ARMY CAMPS (below) access roads must be provided for movement of food and other supplies by motor truck from rail terminals.

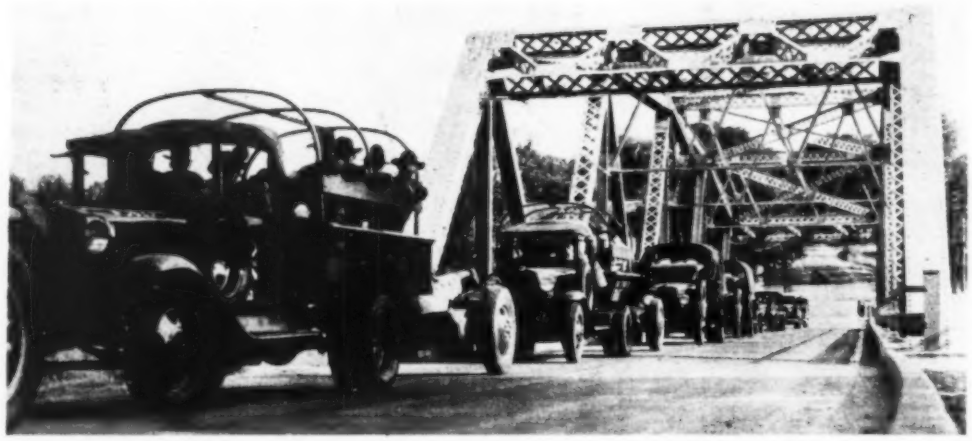
and Navy Departments and allotted for expenditure on contracts let by the Constructing Quartermaster or public-works officers of the various posts. These funds are generally available at present only for certain roads to be improved or constructed within the reservations.

(3) Such amounts of state and local money as can be contributed, in addition to that required in matching the federal-aid apportionments.

State funds for road work undoubtedly will be slightly larger this year than last. State revenues from motor vehicles have been gradually increasing each year. In fact, the increase this year in gasoline taxes is likely to be greater than in any recent year, because of the added volume of traffic in connection with the defense industry and the general stimulation of business by the defense program. The additional money that may be expected from this source will be small, however, compared with the grand total of federal-aid and matching state funds.

The planning work for the construction of access roads can be said to have begun nearly a year ago. At that time Public Roads Administration engineers and military officials began meeting in preliminary conferences, drafting road maps of the various army camp and naval base areas, and making prelim-

(Continued on page 74)



BRIDGE DESIGN providing for standard H-15 loading is ample for carrying all army equipment.

ARMY EQUIPMENT for transporting gasoline and other supplies is designed to impose loads within capacities of modern roads and bridges.

Photos, U.S. Signal Corps

MATERIALS OF CONSTRUCTION in large quantities must be transported over roads to army camps and naval bases now being built.

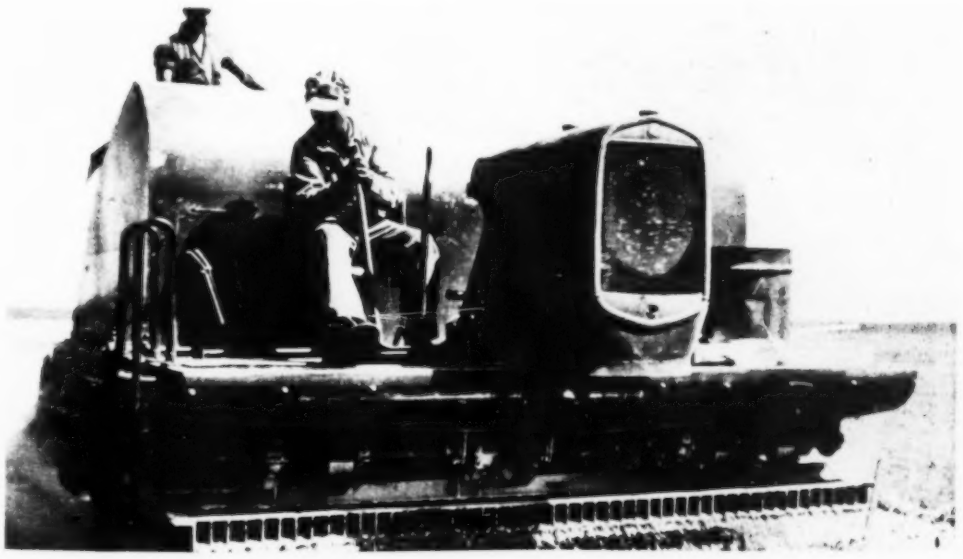
INDUSTRIAL PLANTS engaged in production for defense needs have undergone tremendous expansion in capacity and personnel. Here are acres of parked cars used by employees of Glenn L. Martin aircraft factory near Baltimore, Md., for trip to and from plant by highway.

PORTABLE RAMP towed by self-propelled spreader-roller eliminates delays in charging hopper with dump trucks.

Spreader-Roller APPLIES CHIPS ON CANADIAN AIRPORT

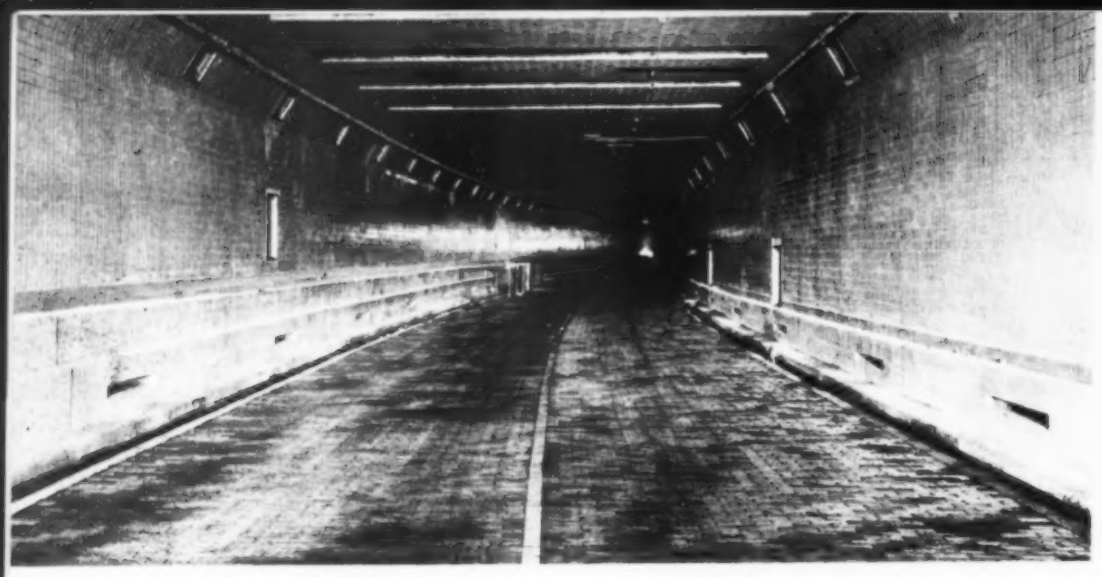
TOWING A PORTABLE RAMP which facilitated charging by dump trucks, a combination chip spreader and roller made rapid progress in applying stone for two 20-lb. surface treatments (inverted penetration type) on the runways of a new airport completed at Calgary, Alta., by the R. G. Taylor Construction Co. as one unit in a chain of airfields being built by this contractor for the Canadian government. Equipped with three 30-in. rollers which compacted a 10-ft. lane in one pass, the Universal spreader-roller used by the contractor at the Calgary airport both spread and rolled the chips in a single operation. Material dumped in the hopper of the machine was fed mechanically to a double-deck vibrating screen which

(Continued on page 94)

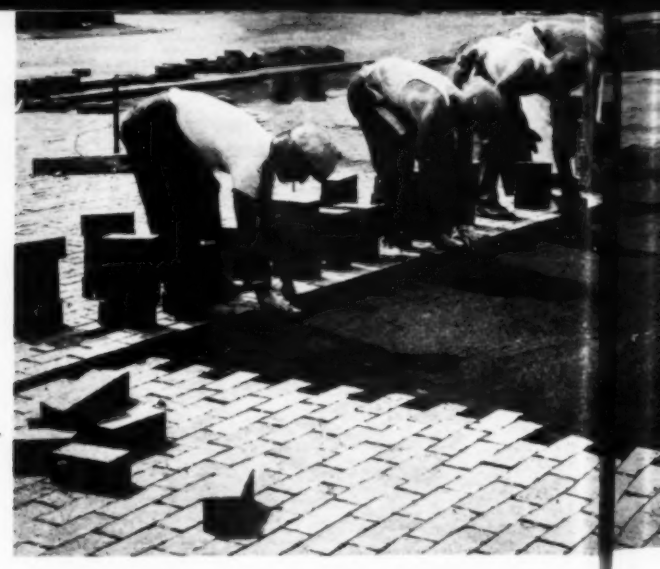


DOUBLE-DECK VIBRATING SCREEN at front of spreader-roller deposits larger chips first and places finer material on top.

COMBINATION SPREADER AND ROLLER puts down stone chips for double surface treatment of inverted penetration type on runways of new Canadian airport at Calgary, Alta.



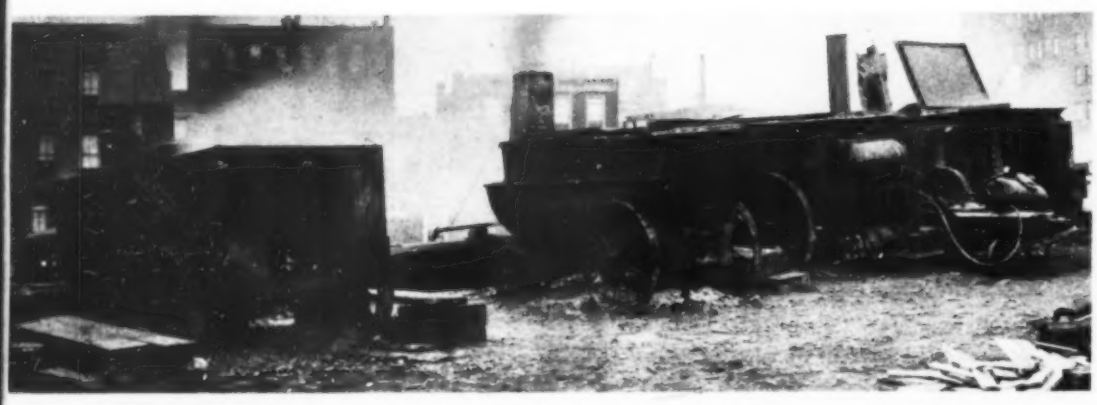
BRICK-PAVED ROADWAYS of twin-tube Queens-Midtown tunnel are 20 ft. wide between 6-in. concrete shoulders, with traffic lane division permanently marked by line of white vitreous blocks.



BRICK DROPPERS lay 3½x4x8½-in. de-aired, wire-cut block on sand-mastic cushion course at tunnel entrance plaza.

VEHICULAR TUNNEL ROADWAYS PAVED WITH *De-Aired Brick*

DE-AIRED BRICK have lugs on one side and ends for proper joint spacing and vertical grooves to insure free flow of hot asphaltic joint filler. In background, note excess joint filler forming mat which is later scraped off. In center is ¼-in. premolded cork expansion joint.

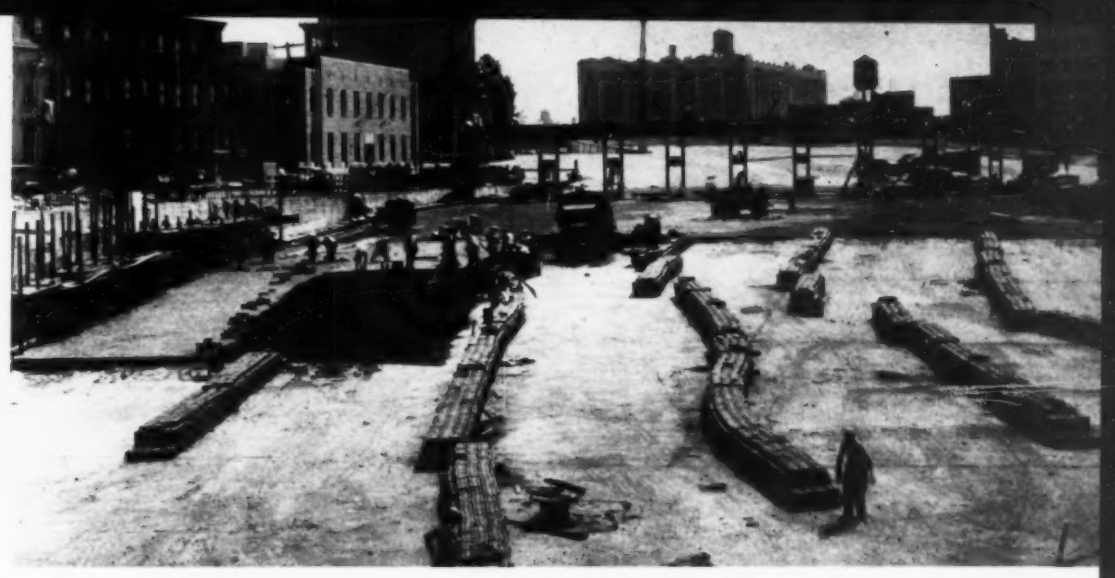


CENTRAL ASPHALT HEATING PLANT for brick joint filler consists of battery of 500-gal. kettles set up outside tunnel on Long Island side to feed smaller portable tanks towed into tubes by tractors.

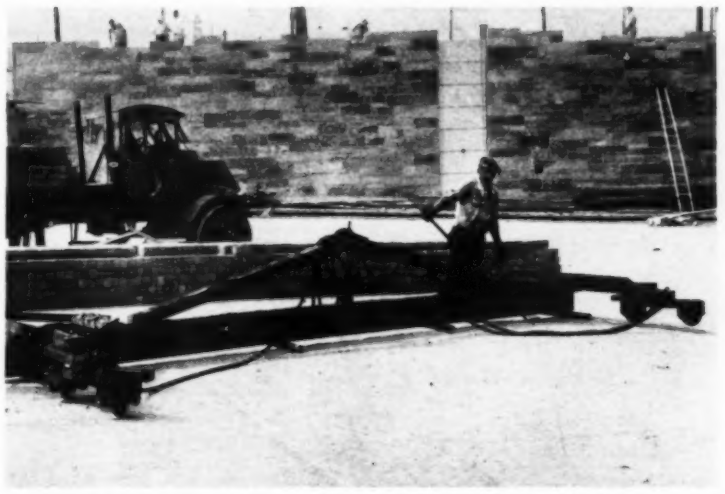
IN PAVING OPEN PLAZAS (below) at ends of tunnel heating kettles supply asphalt to buckets flushed on brick surface to fill joints.

DE-AIRED BRICK, bedded on sand-asphalt mastic cushion and jointed with hot asphalt filler, forms the paved roadways of the $58,000,000 twin-tube Queens-Midtown vehicular tunnel which was opened to traffic Nov. 15, 1940. The new subaqueous route under the East River, built by the New York City Tunnel Authority, makes possible a 3-min. trip by motor car between 36-37th Sts., Manhattan, and Long Island City, in the Borough of Queens. Each of the twin tubes, one for eastbound and the other for westbound traffic, has a roadway generally 21 ft. wide with 20 ft. of brick paving and 6-in. concrete shoulders along the outer edges. The roadway is divided into two traffic lanes separated at the center line by permanent traffic stripes of white vitreous brick markers. On the Manhattan end, because of the shorter radius curves occurring there, the roadway is 23 ft. 6 in. wide consisting of 22 ft. 6 in. of brick paving with 6-in. concrete shoulders along the outer edges; the roadway here is divided into two traffic lanes by a double line of permanent white vitreous brick lane markers, with electrically illuminated

(Continued on page 92)

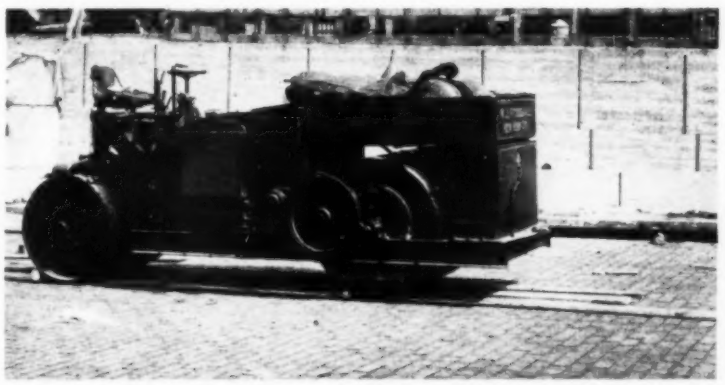


PAVING OF QUEENS PLAZA leading to tunnel shows piles of brick (in foreground) ready for laying. At left center, sand-mastic cushion has been laid and, at extreme left, section of pavement is in place ready for rolling on plank mat.



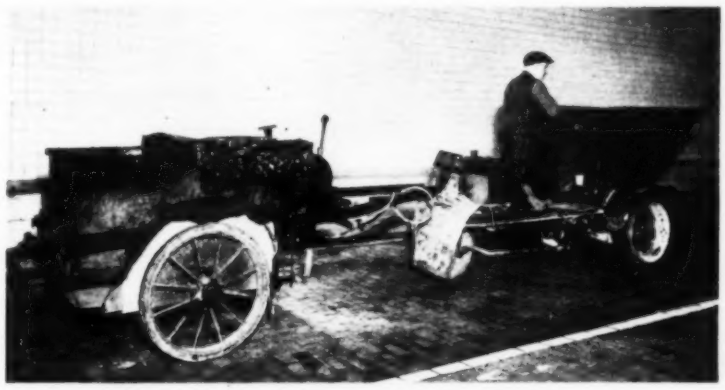
SCREED PULLED BY TRUCK levels off sand-mastic cushion course to specified ¾-in. depth.

PRIME COAT of cut-back asphalt is sprayed on concrete base of tunnel plaza to provide bond with sand-mastic cushion course on which brick are bedded.



PLANK COVER, laid over brick to carry 5-ton roller, equalizes pressure and prevents bricks from being tipped or shoved during bedding in mastic cushion course.

SEPARATING AGENT of calcium chloride, starch and water is sprayed on surface of brick by hand pump on tank to prevent adhesion of excess joint filler (in foreground) which is being flushed on with pails.

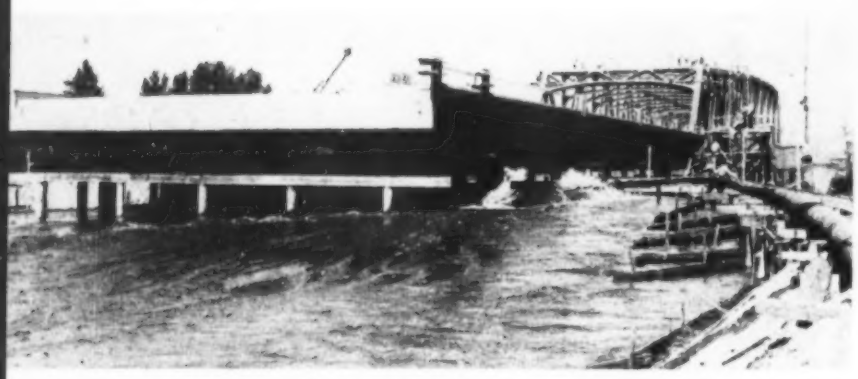


HOT ASPHALT JOINT FILLER is delivered into tunnel in 300-gal. tank hauled by rubber-tired tractor.

HAND SCRAPERS (below) remove excess joint filler from brick-paved surface. Separating agent, sprayed on brick, destroys adhesion of asphalt.

ADAPTING WASHINGTON STATE HIGHWAYS TO *National Defense Needs*

By JAMES A. DAVIS
Acting Director
Washington State Department of Highways



HYDRAULIC FILL to form south approach to Lewis River bridge is made by General Construction Co., of Seattle, using dredge to pump coarse sand from river bed through 15-in. pipe line.

JACKS LOWER STEEL GIRDERS into place at railway undercrossing near Ritzville on contract of Henry Hagman.

FILL OF BOULDERS AND CLAY (below) near Skykomish is built by L. Romano Engineering Co., using tractor-bulldozer outfit.

MILITARY SERVICE ROADS of asphaltic concrete are built by state forces at Fort Lewis, U. S. Army camp on Pacific Highway.

LEWIS RIVER BRIDGE on Pacific Highway, being built near Woodland by MacRae Bros., of Seattle, will provide 48-ft. roadway. Steel is brought in by high-line cableway for erection by stiff-leg derrick.

FOUR-LANE CONCRETE PAVEMENT, with 4-lt. bituminous-surfaced dividing strip, is built by Sather & Sons, of Seattle, on east-west route between Spokane and Idaho state line.

TWO CARRYALL SCRAPERS, in tandem, are used by Henry Hagman, contractor, of Cashmere, Wash., to remove embankment for railway grade separation near Ritzville.

JAMES A. DAVIS, acting director, Washington State Department of Highways.

WASHINGTON STATE HIGHWAYS have been built primarily to meet the transportation needs of a people engaged in the pursuits of peace, and with little or no consideration of their use for military or wartime activities. But now, with so much of the alleged civilized world actively engaged in warfare, and our own country already committed to and embarked upon a gigantic program of preparedness for national defense or war, attention is being directed, as never before, to the improvement of highways as a vital part of the defense program.

The War Department, in collaboration with the Public Roads Administration, has designated certain of Washington's highways as roads of strategic importance, and a study has been made for the purpose of ascertaining the nature, extent and probable cost of improvements necessary to make these roads conform to military standards. The study was based upon and greatly facilitated by maps and data of the State Planning Survey, made cooperatively by the Public Roads Administration and the Washington Department of Highways under provisions of the amended Hayden-Cartwright Act of 1934. The system as outlined embraces about 900 mi. of first priority roads, 1,400 mi. of second priority and 200 mi. of third priority. Each priority has been studied separately and the items covered by the cost estimate have been grouped under the following headings:

(1) Right-of-way
(2) Grading and minor drainage
(3) Parking shoulders
(4) Surface
(5) Major structures

Roads of the first priority, in their present condition, would rate fairly high as measured by military standards. Grades and alignment, with some few exceptions, are satisfactory. About two-

(Continued on page 103)

SPREADING AND COMPACTING FILL in layers **(below)** on four-lane highway between Seattle and North Bend is done with bulldozers and sheepsfoot rollers hauled by tractors operated by N. Fiorito, contractor, of Seattle.

CONTINUOUS CENTRAL MIXING PLANT comprising four portable pneumatic-tired units is set up at quarry site to produce material for West Virginia road resurfacing job. Trucks take unclassified aggregate from wooden overhead bin under shaker screen of crushing plant, at right, and back up short ramp to dump material into hopper feeding bucket loader of dryer unit. Dried aggregates are transported by belt conveyor to gradation control unit, at left, which classifies and proportions material for delivery to mixer. At extreme left, continuous pug-mill mixer discharges paving material into truck.

Gradation Control

Assures Aggregate Uniformity in Continuous Asphalt Plant

GRADATION CONTROL UNIT, consisting of vibrating screen, three-compartment steel bin, apron feeder with calibrated gates and inclosed bucket elevator, separates aggregate into sizes and recombines them in proper proportions for delivery to mixer at right. Apron feeder and bucket elevator are driven by mixer power unit and are synchronized with pug mill and bitumen metering pump to maintain uniform ratio of mixture ingredients.

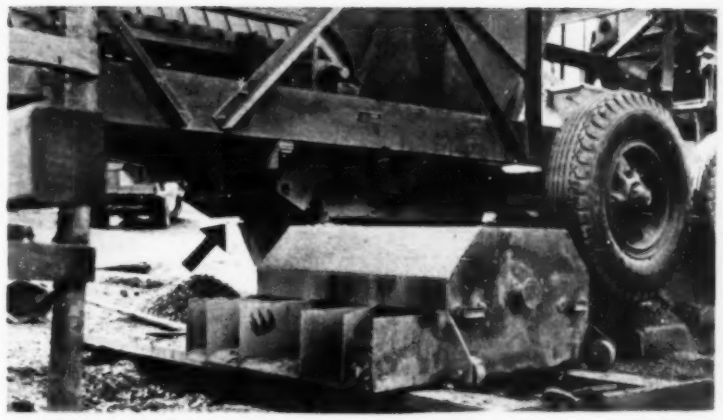
ACCURATE, UNIFORM PROPORTIONING of aggregates in asphalt mixtures resulted from introduction by the Murphy Construction Co., Morgantown, W. Va., of a newly developed gradation control unit in the production line of a central plant for continuous mixing of paving material used in resurfacing 8 mi. of U. S. 50 near Mount Storm, in West Virginia's eastern panhandle, under direction of the State Road Commission. Operating with an accuracy which closely matched that of the asphalt metering pump on the mixer, the gradation unit maintained constant control of aggregate proportioning and supplied stone gradations of practically unvarying uniformity for the various classes of mixtures employed in patching old asphalt macadam and in laying binder and wearing courses. The mixes incorporated stone gradations ranging from

PLANT OPERATION is supervised by: (right to left) PAUL A. FEATHER, assistant manager, Murphy Construction Co.; GEORGE LIPSCOMB, job superintendent; and H. B. WILSON, plant inspector for West Virginia State Road Commission.

TWIN DRYER DRUMS mounted in parallel on frame of pneumatic-tired trailer unit discharge dried aggregate on to belt of 55-ft. conveyor.

nominal ⅜-in. to 1-in. for binder course to a 40-mesh to ½-in. size for dense top course; RC-4 cut-back asphalt was added to the mixes in the required proportion to give bitumen contents varying from 3 to 5.15 per cent. For all classes of mixes, the continuous central plant demonstrated a consistent ability to control the proportions of the ingredients and eliminate variations in the mixed material.

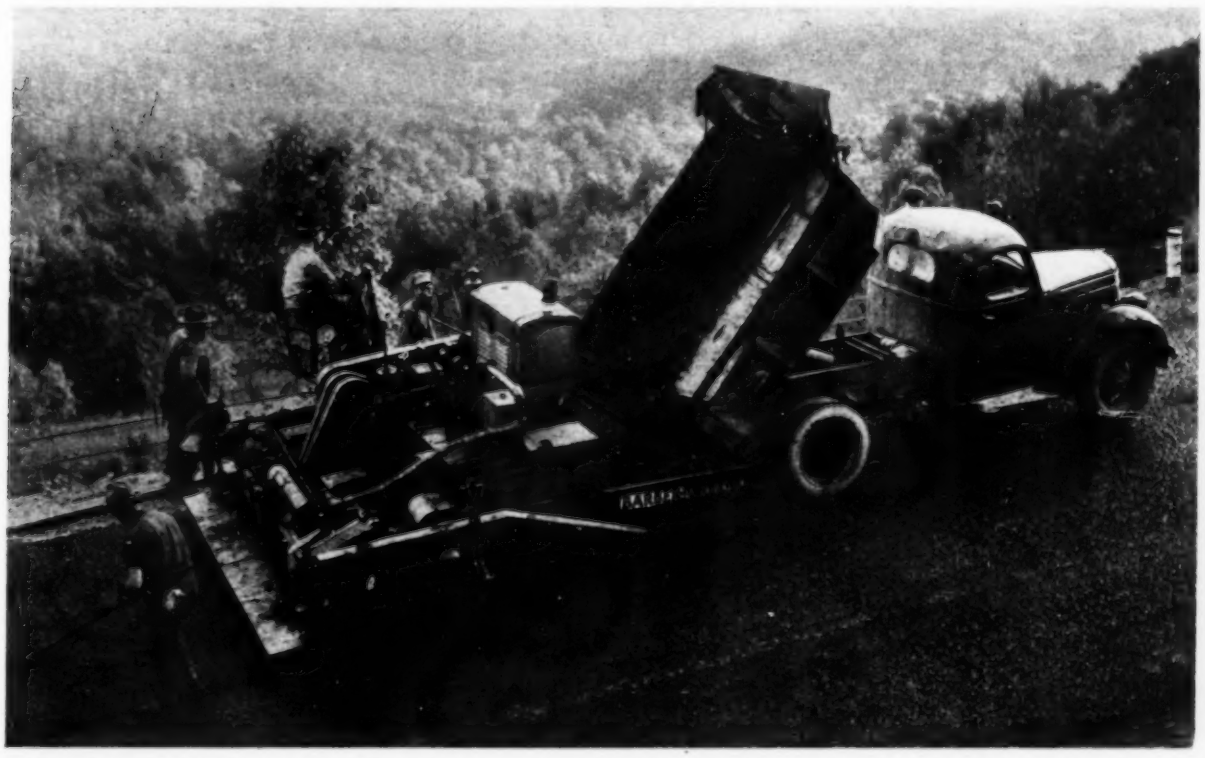
To save rehandling of aggregates, the contractor set up the central plant adjacent to a crushing and screening outfit previously installed at a quarry yielding a good grade of hard limestone. Because this location was a maximum haul distance of 35 mi. from the far end of the resurfacing job, the mixing plant was adjusted to operate at a capacity of 80 tons an hour, although the mixes could as easily have been produced at the rate of 100 tons an hour. The complete central plant comprised four Barber-Greene portable units mounted on pneumatic tires for easy mobility. At the starting end of the production line, a reciprocating plate feeder and a bucket elevator delivered unclassified crushed aggre-



TO DETERMINE DISCHARGE RATES through calibrated gates for various classes of aggregates, three separated sizes are drawn off through by-pass chute (indicated by arrow) into special three-compartment steel box mounted on rollers.

THREE-COMPARTMENT STEEL BOX catches separated sizes of aggregate drawn off through calibrated gate of gradation unit. This photograph although made on another job, illustrates accuracy of gradation control. Yoke for lifting box by chain hoist is attached.

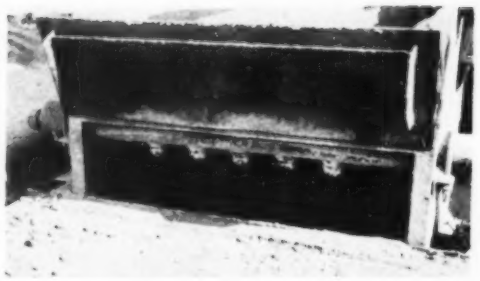
CHAIN HOIST on I-beam trolley boom picks up steel box to discharge trapped samples of three aggregates into separate containers for weighing. By this procedure, gates are calibrated for rates of discharge at various openings.



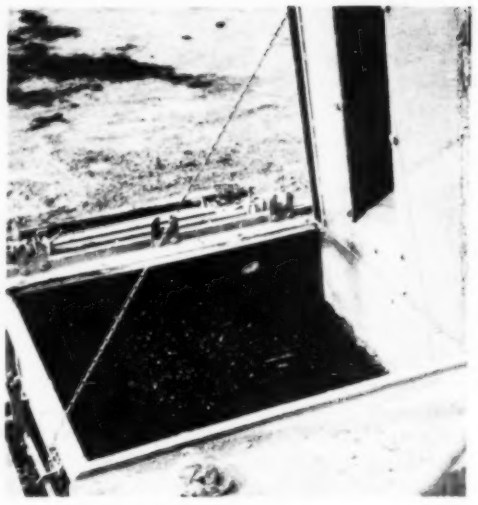
PUSHING DUMP TRUCK ahead of it up mountain grade, self-propelled paving machine equipped with leveling and tamping devices lays ¾-in. top course on 1-in. binder course previously placed in same way.

GENERAL CONTROL of mix design is in hands of A. M. MILLER, assistant materials engineer, State Road Commission.

RECIPROCATING PLATE FEEDER transfers controlled, uniform stream of aggregate from hopper to bucket elevator loading dryer drums.



FIVE PRESSURE SPRAYS apply metered quantity of cut-back asphalt to graded aggregates entering pug-mill mixer through spray chamber.



BY RAISING HOOD, observer gets a look at homogeneous mixture produced by continuous pug mill 8 ft. in length.

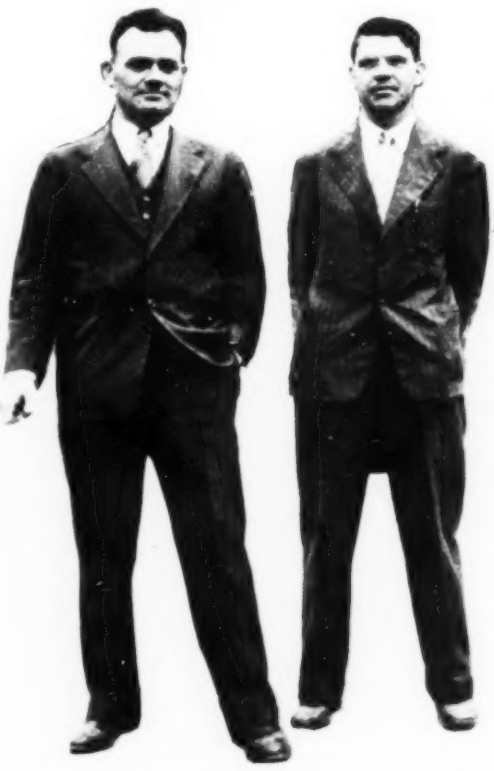
ROAD RESURFACING is directed by B. D. JOHNSON (right), construction engineer, with H. C. MANNING as inspector on job.

gate to a dual drum dryer consisting of two drums mounted in parallel on the chassis of one of the portable units. From the dryer, a portable 55-ft. belt conveyor elevated the dried aggregate to a vibrating screen at the top of the gradation unit, which separated and recombined the material in the proper proportions for delivery to the heavy-duty continuous pug-mill mixer, the fourth and final unit in the line.

Gradation Unit—Component parts of the gradation unit included the vibrating screen, a three-compartment steel bin, an apron feeder with calibrated gates and an inclosed bucket elevator. Aggregates conveyed to the vibrating screen were separated into sizes for temporary storage in the three bin compartments, which had nominal capacities of 5 to 7 tons. Under the bin was the apron feeder, to which classified material from the three con.partments flowed in proportioned quantities through the calibrated gates. Special equipment to facilitate calibration of the gates for various classes of aggregates was furnished with the gradation unit, as will be noted later. By this means the plant inspector developed calibration graphs which, in conjunction with his analyses of the materials in the three compartments, enabled him to determine the proper gate openings to pass the aggregate in desired proportions and quantities.

Graded aggregate was dropped by the apron feeder into the boot of the in-

(Continued on page 108)



RESIDENT ENGINEER in charge of construction for District 5 is C. R. NUZUM (right), standing here with PAUL A. FEATHER.

BEHIND FINISHING MACHINE, 10-ton three-wheel roller completes compaction of material in each of two resurfacing courses.

MULTI-PURPOSE BUCKET LOADER previously used in conjunction with continuous mixer on travel plant jobs here loads material out of stockpile for dense top course mixture.

Oddities

CLOVER LEAF

As I was going to St. Ives
On one of my impromptu drives,
I met that scourge of modern brains,
A clover leaf with seven lanes.

Each lane had seven exits;
Each exit had seven signs;
Each sign had seven directions,
And each direction had seven lines.

Pressing my foot upon the gas,
I sped across the overpass;
And when I reached the other side
An underpass I now descried.

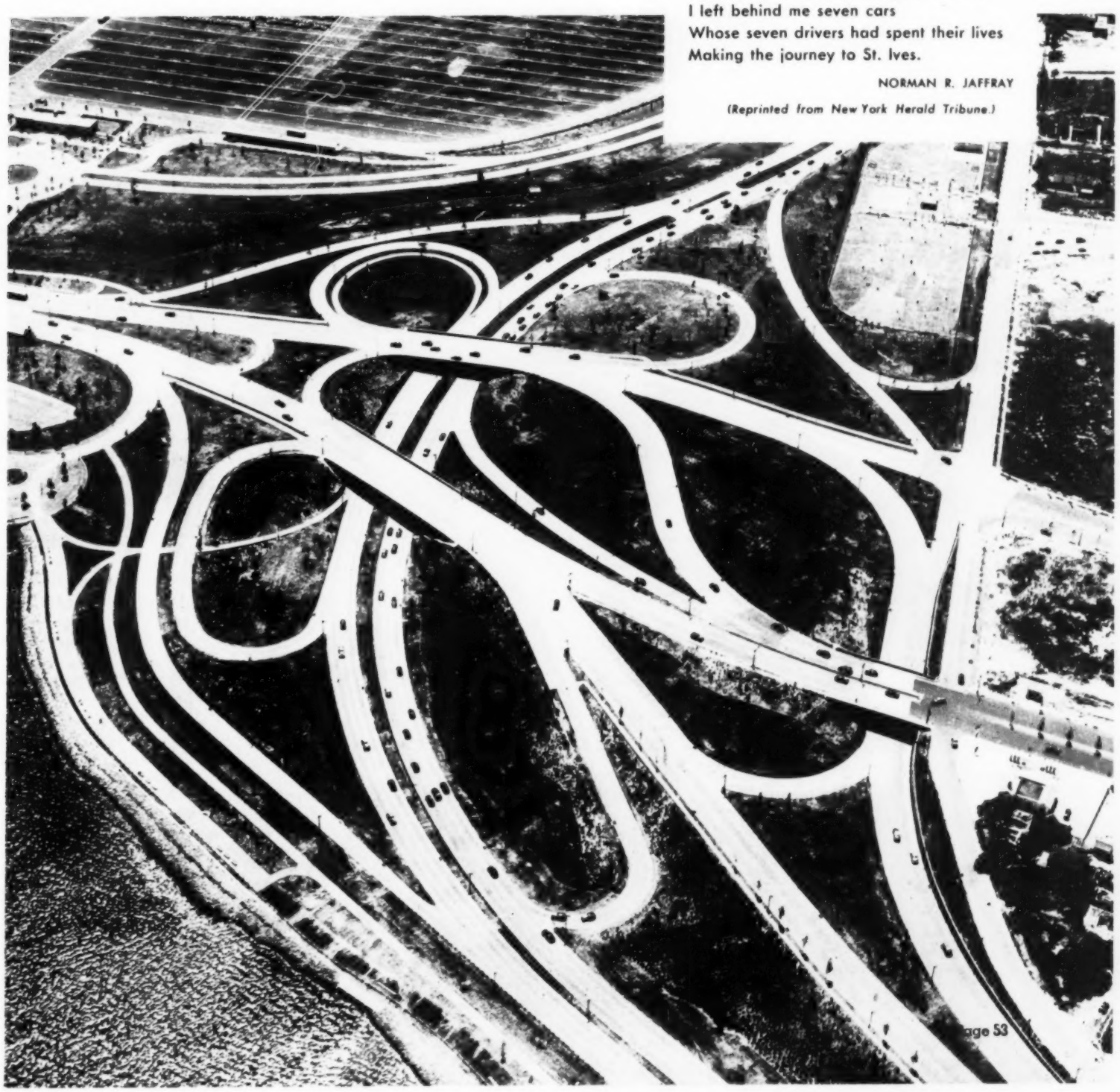
Each pass had seven bends;
Each bend had seven curves;
And each new twist my auto took
Unhinged by sevenfold my nerves.

Crashing to freedom through the bars,
I left behind me seven cars
Whose seven drivers had spent their lives
Making the journey to St. Ives.

NORMAN R. JAFFRAY

(Reprinted from New York Herald Tribune.)

Arnold & Kellogg Photo



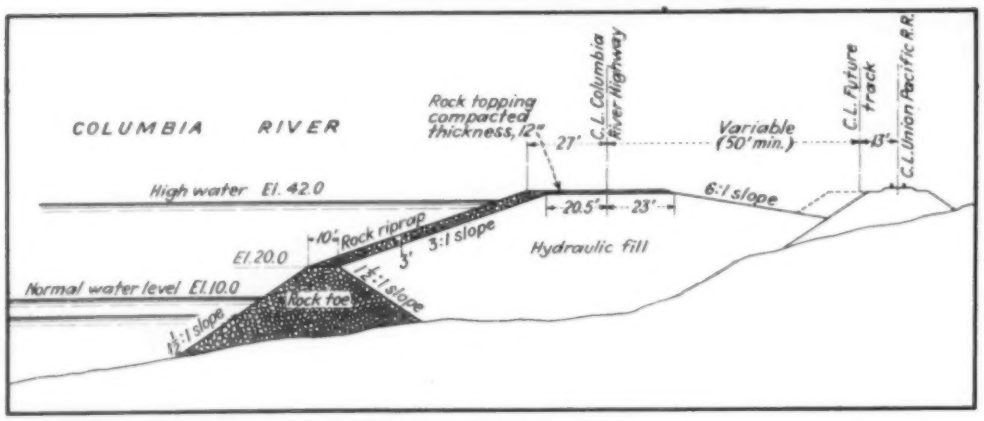
HYDRAULIC FILL for the new Columbia River highway is sandy material pumped through 15-in. pipe line from streambed by dredge. Embankment is protected by rock toe wall and is paved with riprap 3 ft. thick.

HYDRAULIC DREDGE in Columbia River pumps sand to form new highway fill.

Dredged Fill

From Columbia River Carries Parkway Through Gorge

By R. H. BALDOCK
Chief Engineer, Oregon State Highway Commission

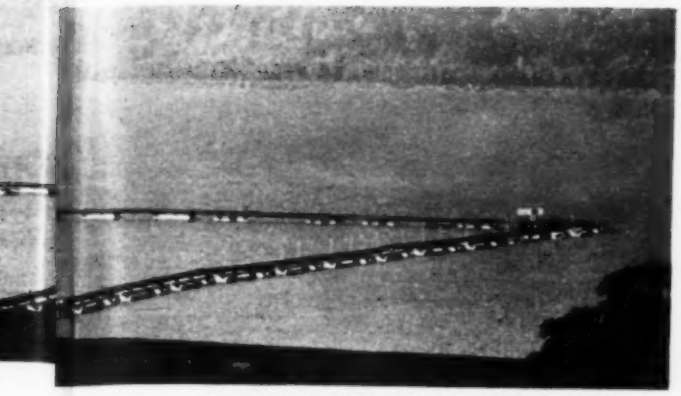


CROSS-SECTION of hydraulic fill with rock toe along river.

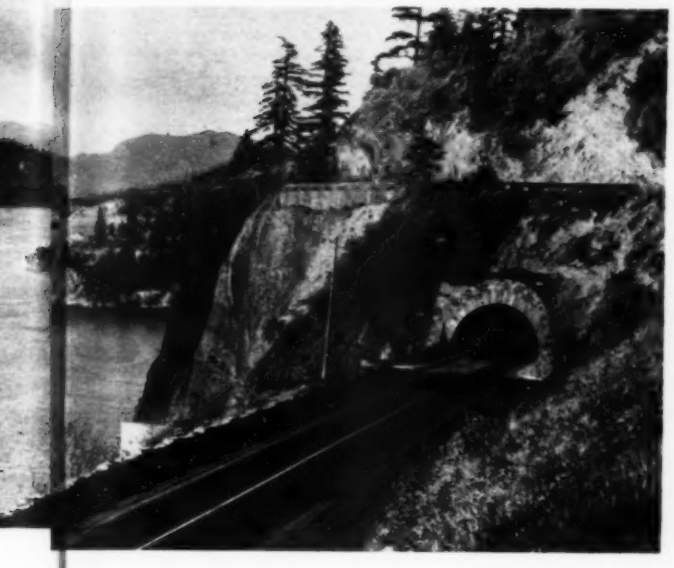
WHILE MAJESTIC SCENIC VISTAS are exposed to view, military needs will be served directly by the new 70-mi. parkway which the Oregon State Highway Commission, in cooperation with the Public Roads Administration, has started to build through the Columbia River Gorge east of Portland, following the only natural water grade route through the Cascade Mountains. Supplementing the existing Columbia River highway, which hangs along the side of the basalt palisades and is unsuited to modern high-speed traffic, the new road-

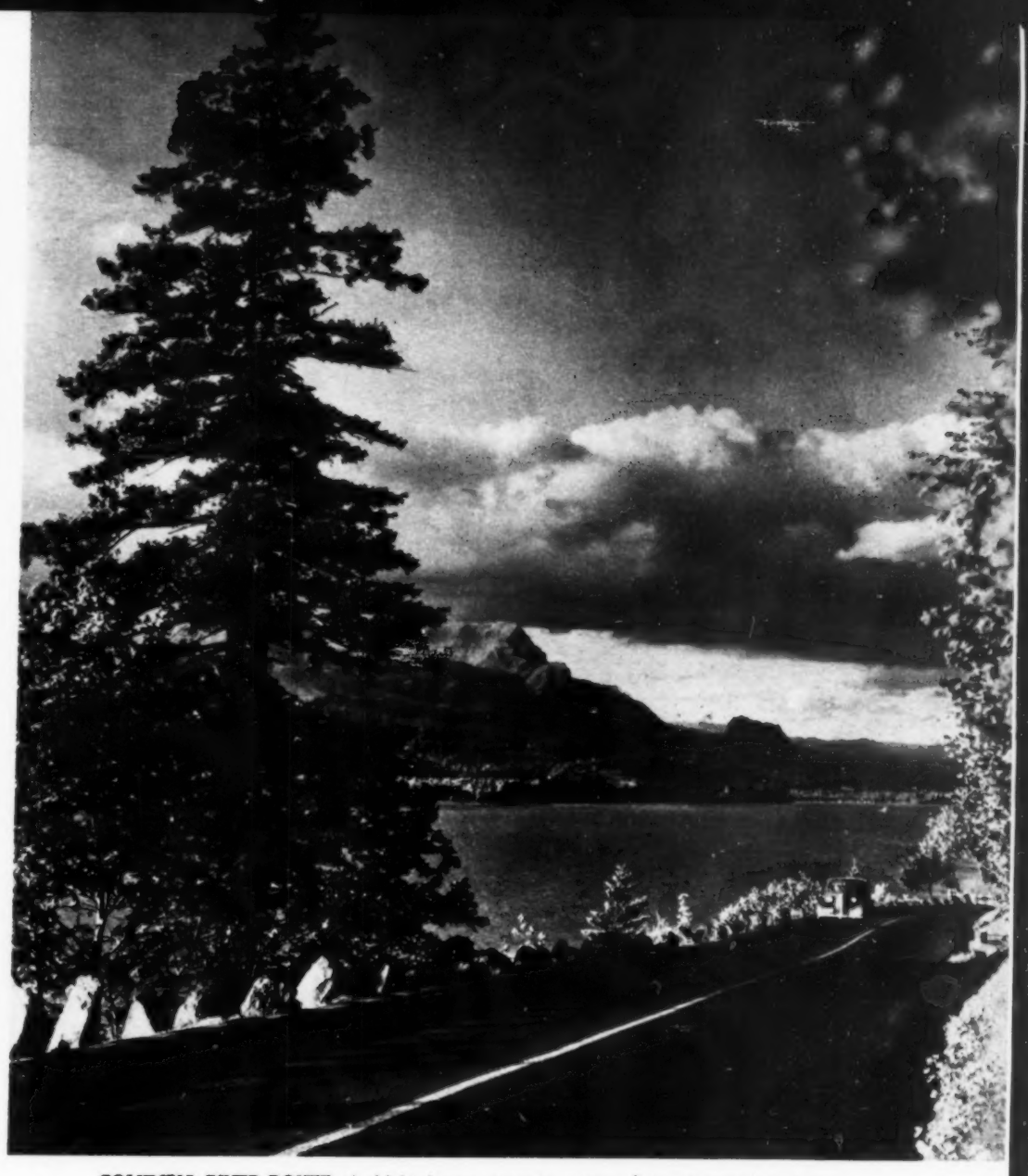
ONE OF THE QUARRIES (below) from which rock is loaded by power shovel into trucks and hauled 1 mi. to form river toe wall along embankment.

FLASH BOARDS (below) control flow of pumped sand on top of embankment to provide new highway location.



NATURAL WATER GRADE ROUTE (below) is followed by new Columbia River highway. This view shows highway entering Tooth Rock tunnel.





COLUMBIA RIVER ROUTE of old highway presents vistas of impressive beauty.

way presented a difficult construction problem because of its location through the rough terrain of the spectacular gorge. The solution was found, for the first 18-mi. section of the route between Troutdale and Dodson, in stepping out boldly into the river and building in water 30 to 60 ft. deep a fill of material dredged from the streambed and retained by a rock toe wall to prevent erosion. In some places the river current is directed against the Oregon shore and in others there is slack water.

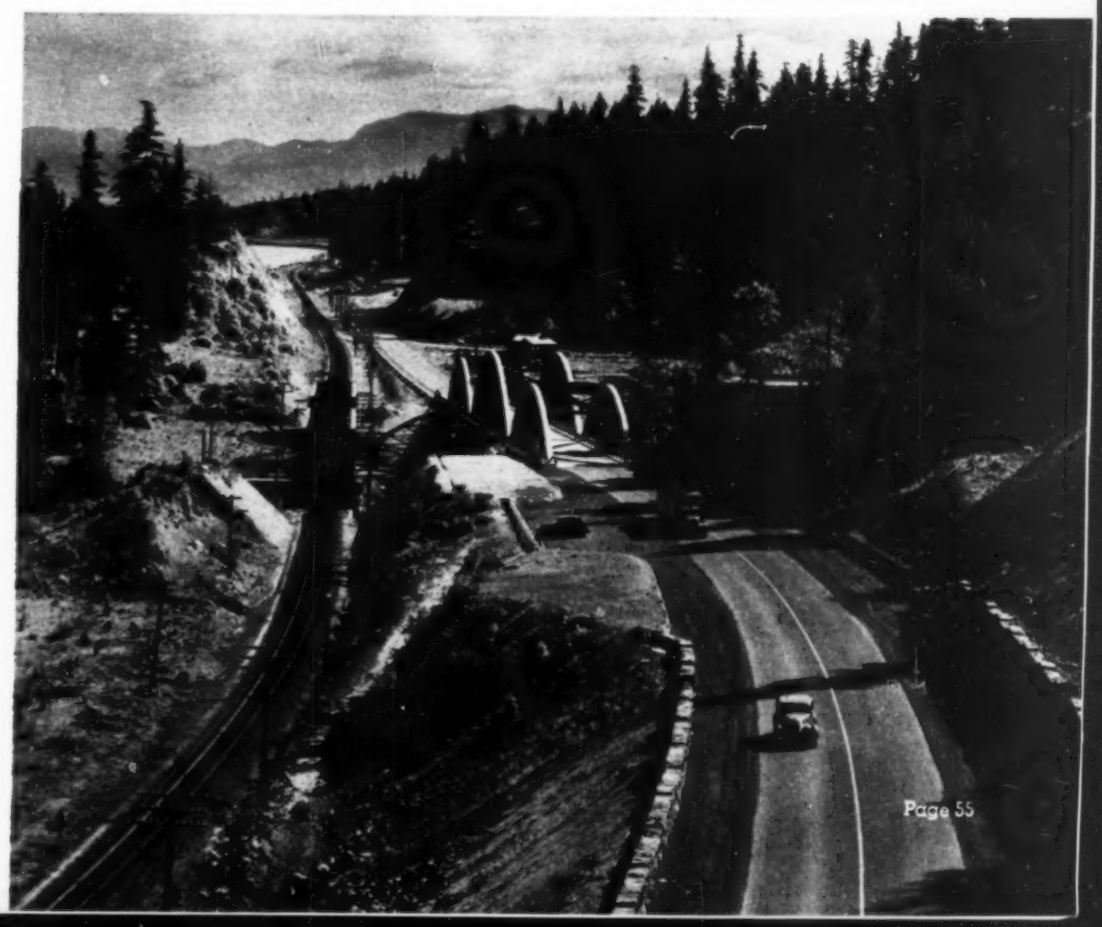
To provide a parkway, the state has acquired all the land on the river side of the Union Pacific railroad from a point near the town of Troutdale, 15 mi. out of Portland, to Dodson, some 18 mi. farther upstream. Work is under way on this part of the route and the parkway probably will be extended later to a total length of 70 mi. up the river.

Rock Toe Wall for Fill

On about one-third of the 18 mi. the fill slopes will be subject to the strong current of the river, and the construction plan provides for first building up a rock toe wall, dumped from trucks. This toe wall constitutes the lower part of the outer facing of a dredged fill wide enough to carry the roadway. The toe wall is completed, and hydraulic dredges

(Continued on page 98)

CROSSING OF EAGLE CREEK (below) on new Columbia River discloses scenic splendors of gorge. At left is track of Union Pacific Railroad.

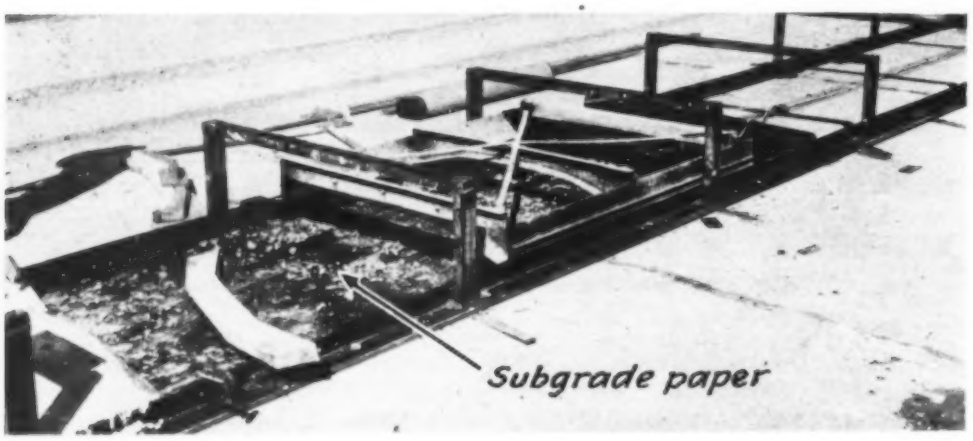


INDIANA

Salvages Old Slab

FOR U.S. 20 WIDENING

WIDENING OF U. S. 20 (left), indicated by broken line on this map, extends four-lane divided pavement 16½ mi. eastward toward South Bend, leaving only 12 mi. of four-lane construction to be completed on present location of State Road 2 under 1941-42 program.



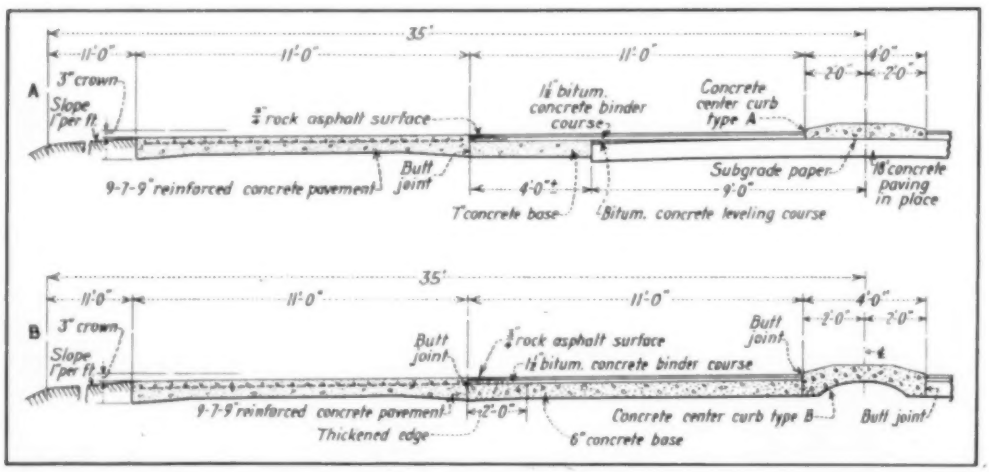
STEEL MULE riding on curb forms strikes off gray concrete core of center curb for Rieth-Riley Construction Co. Note subgrade paper laid on salvaged concrete base.

RAINY DAY CONFERENCE (left) brings together ROBERT E. O'CONNOR (right), of J. C. O'Connor & Sons, Inc., and A. D. BLACKBURN, superintendent on this firm's two contract sections.

TEMPLATES AND LEVELS guide setting of steel-frame center curb forms from established line and grade of completed 11-ft. outer concrete lane on Rieth-Riley contract.

TO SAVE THE COST of excessive land acquisition for right-of-way on a widened 12-mi. stretch of U. S. 20 near Michigan City, Ind., engineers of the Indiana Highway Commission designed a pavement of 48-ft. overall width, with two 22-ft. roadways separated by a white concrete center curb 4 ft. wide. For the construction of this curb, the Rieth-Riley Construction Co., Goshen, Ind., and J. C. O'Connor & Sons, Inc., Fort Wayne, Ind., developed special forms and strike-off templates which enabled their crews to complete the separating barrier at rates up to 1,600 lin.ft. per 8-hr. day.

Heavy traffic on U. S. 20, an essential strategic highway connecting South Bend and Chicago, required widening of the existing 18-ft. slab and improvement of the irregular longitudinal profile, with its inadequate sight distances. By thrifty design of the widened pave-



ECONOMICAL DESIGN of widened pavement for narrow right-of-way salvages old 18-ft. concrete slab wherever possible and uses it as part of base under asphalt surface of inner lanes, as shown by A above. Where old slab is not available, 6-in. plain concrete base is placed for inner lanes, as indicated by B. Concrete center curb with white concrete top separates two roadways of divided four-lane pavement.

BRASS SHAPING TROWEL conforming to curb profile follows hand screed on white concrete and gives a good finish to exposed surface of median barrier 4 ft. wide.

WATERPROOF PAPER for curing is cemented with sealing compound to vertical edges of curb. Note recesses for light reflection at night. At left is D. T. GOODE, in charge of curb construction on Rieth-Riley job.

ment, highway grades were adjusted to preserve existing slab wherever possible and to utilize it as base under bituminous surface on the inner lanes. The outer lanes are new reinforced-concrete slabs of 9-7-9-in. cross-section.

A continuation of the four-lane pavement to the east extends the present improvement 4.6 mi. toward South Bend on the present location of State Road 2, as shown on a map reproduced with these notes. In this area, lower land costs made additional right-of-way purchases less expensive, and the extension is being constructed on 150-ft. right-of-way which permits separating the two 22-ft. concrete roadways with a 30-ft.

TWO 27E PAVERS (below) operate in combination to build 9-7-9-in. reinforced-concrete outer lane on O'Connor sections. First mixer places lower course of two-course construction, while second places top layer and fills occasional gaps left in bottom course.

TWO STEEL MULES, one for gray concrete core and second for white concrete top, are used by J. C. O'Connor & Sons on curb construction. Steel forms in 15-ft. lengths have welded tie-frames spaced 5 ft., c. to c.

THREE TYPES (below) OF WHITE CONCRETE CENTER CURB are used in continuous median barrier between roadways of widened pavement. Type A is built on salvaged slab, and types B(1) and B(2) are placed on earth subgrade.

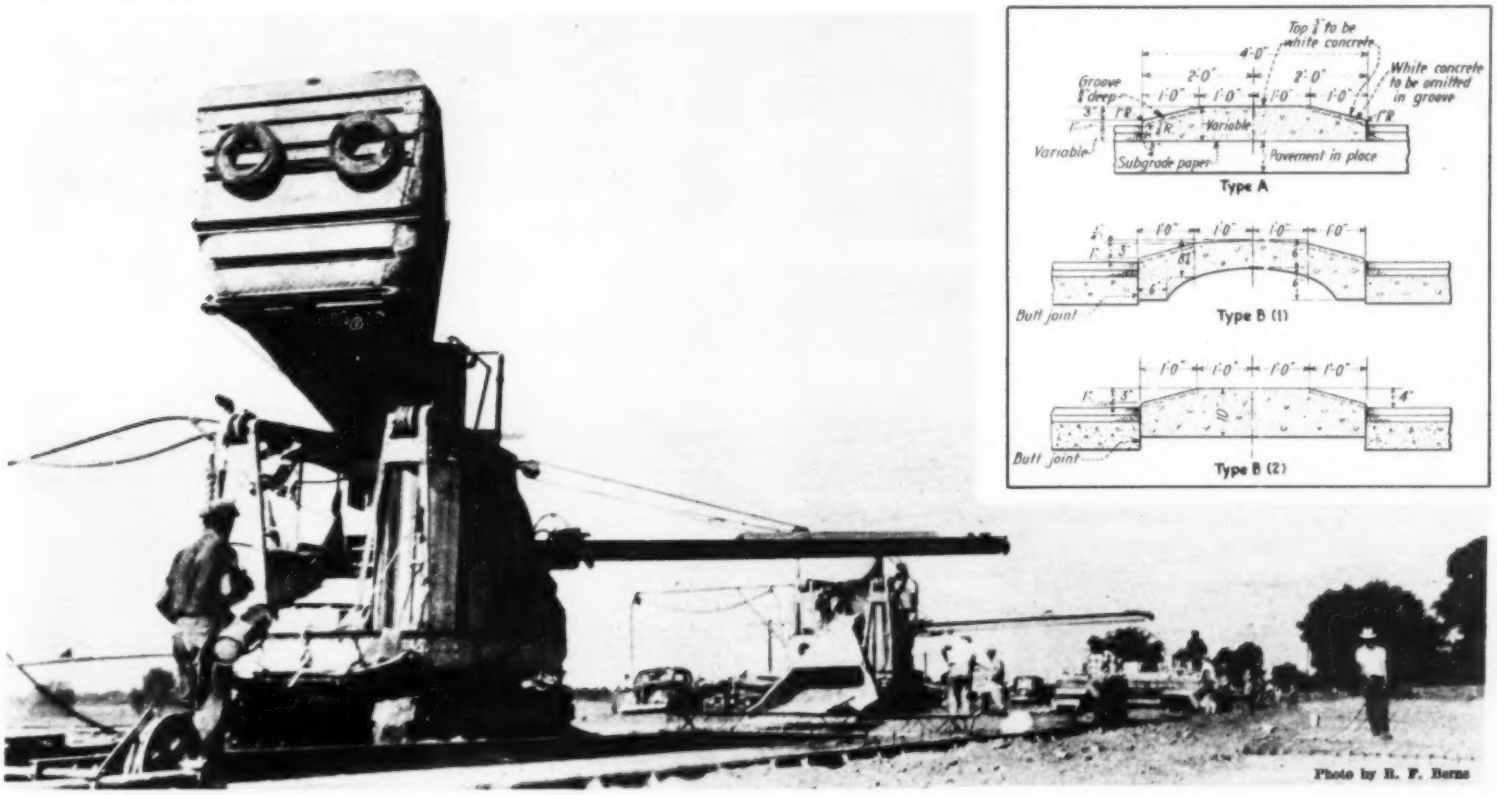


Photo by R. F. Berns

ENGINEERS collaborating on Indiana's U. S. 20 improvement include: (Starting at right) F. E. BERNOSKE, district engineer; HAROLD BOWEN, project engineer; R. F. BERNS, assistant district engineer of construction; and W. R. WOOLEY, associate highway engineer, Public Roads Administration.

REVOLVING AIR HAMMER RIG mounted with compressor on truck turntable by Chicago Concrete Breaking Co. demolishes slab at rate of 30 sq. ft. or more per minute for Bontrager Construction Co.

ROCK ASPHALT SURFACE COURSE is placed on inner lane by black top spreader equipped with hopper into which trucks dump. Asphaltic concrete binder course is laid by same method. Paper on center curb protects white concrete.

PAVER BUCKET deposits gray concrete to be struck off for core of center curb by winch-operated mule on O'Connor curb.

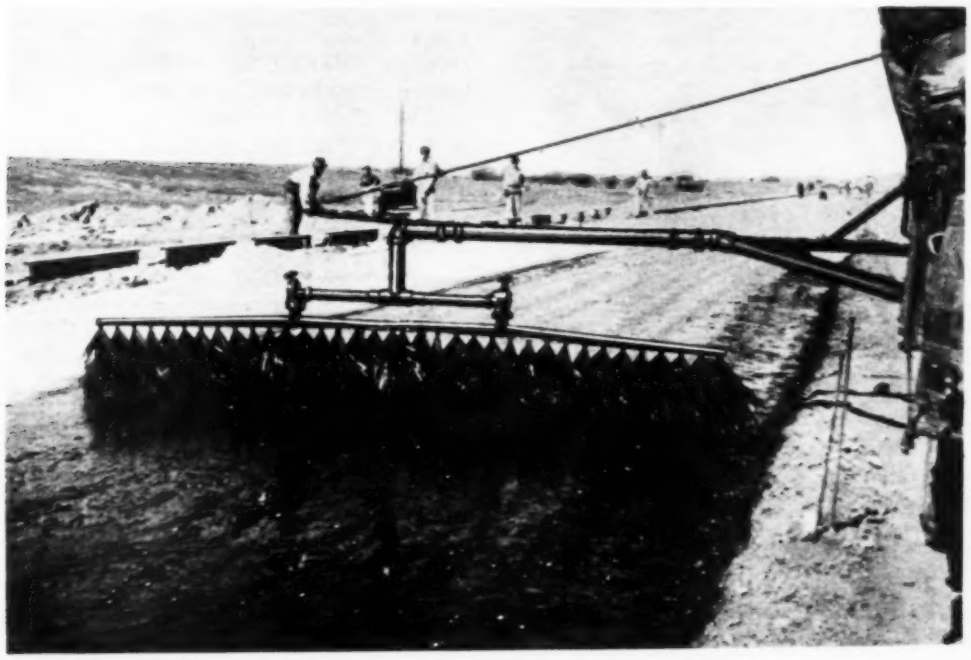
grass strip, conforming to Indiana's standard design for four-lane divided pavement in rural locations. Because of the extremely irregular "roller-coaster" profile of the existing pavement on S. R. 2, it was impossible to incorporate any of the old slab in the reconstruction, and the concrete was broken up and removed as one of the first operations by the Bontrager Construction Co., Elkhart, Ind., contractor on this section. Under the Indiana construction program for the fiscal year 1941-42, the four-lane divided highway will be extended the remaining 12 mi. eastward on the location of S. R. 2 to South Bend, completing the last link in four-lane pavement between this city and Chicago. Plans are rapidly being developed for the remaining contracts, and this work is expected to be under construction early in the spring of 1941.

Salvaged Slab — Of 11.8 mi. of actual construction involved in the widening of U. S. 20 between S. R. 212 and S. R. 2, about 3 mi. is on new location, leaving about 8.8 mi. on which there was any possibility of salvaging the old 18-ft. slab. By control of the highway grades, the new design actually preserved 52,000 sq.yd., or nearly 5 mi., of the old concrete and incorporated it as base in the new four-lane pavement. To

(Continued on page 80)

PAIR OF TRANSVERSE BLADING SPREADERS work with first and second pavers to strike off concrete placed in two courses. Behind second spreader are two finishing machines used with this paving outfit.

ASPHALT SEAL applied to clay subgrade which has been wetted to capillary capacity is relied upon to prevent evaporation losses and to assist in maintaining constant moisture content.



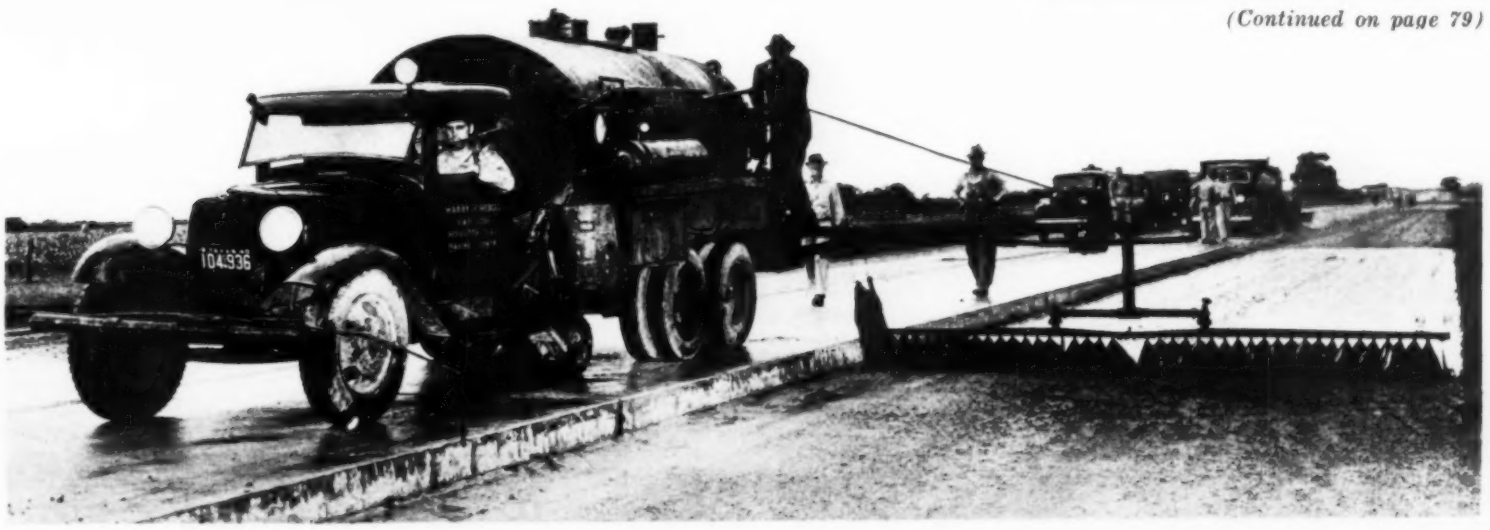
SPECIAL OUTRIGGER equipped with heated pipe enables distributor traveling outside subgrade to apply hard asphalt in cool weather.

Asphalt Seal

PREVENTS MOISTURE CHANGES IN CLAY SUBGRADE

TO PREVENT VOLUME CHANGES in subgrade sections of predominantly clay soil on a 42-mi. concrete paving project recently completed by three contractors for the Texas State Highway Department on State Route 73 between Houston and San Antonio, the specifications required that the subgrade soil be wetted to about its maximum capillary capacity and that the surface then be sealed with an asphalt membrane. Harry H. Hedges, asphalt contractor,

(Continued on page 79)



AFTER CONCRETE SLAB has been completed, distributor seals shoulders at subgrade elevation with hot asphalt applied by outrigger spray bars.

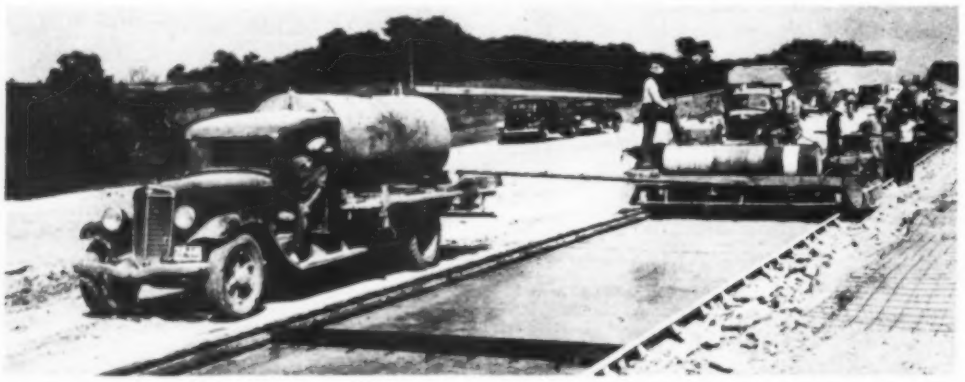
TRACTOR-DRAWN TANDEM WAGON OUTFIT, made up of 14-yd. side-dump track wagon and 12-yd. bottom-dump trailer unit mounted on two pneumatic tires, is loaded by 2-yd. diesel shovel excavating earth cut.

FAST GRADING AND PAVING

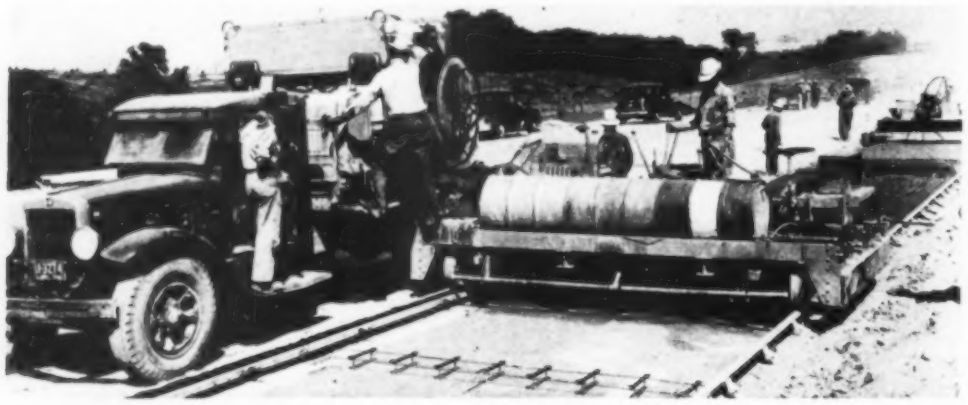
Save One Year

ON OHIO RELOCATION JOB

DITCHING MACHINE cuts trench for 8-in. concrete pipe drain in clay cut, while tractor-drawn 14-yd. scraper grades track on which traction ditcher can operate. Subgrade in this cut will be drained by 4-in. cross drains installed in herringbone pattern leading to 8-in. ditch drains.



SPRINKLER TRUCK wets subgrade ahead of concrete spreader traveling on steel forms for 11-ft. lane.



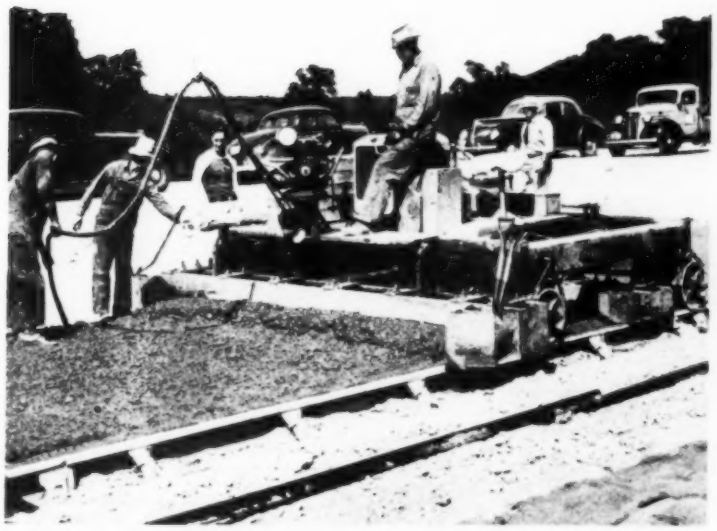
SPRAY BAR ATTACHMENT fed from drums on concrete spreader wets subgrade where necessary as unit moves ahead distributing concrete delivered by side-discharge truck mixers. Spreader strikes off first course of concrete 2 in. low to receive mesh reinforcement.

BY CONCENTRATING a mass of fast-moving grading equipment and a high-production paving outfit featuring side-discharge truck mixers on a 6½-mi. relocation of U. S. 40 near Zanesville, Ohio, Ralph Myers, Salem, Ind., contractor, assisted by Hussey & Holderman, Columbus, Ohio, subcontractors on paving, moved 1,200,000 cu.yd. of earth and rock and laid 84,000 sq.yd. of concrete slab during the 1940 construction season, completing the work on this section of the strategically important east-west highway in eight months of an allotted 20-month contract period. The ink was hardly dry on the contract before 20 carloads of earth-moving equipment with an estimated replacement value of $700,000 arrived on the $750,000 project, ready to go to work as quickly as stakes could be set on right-of-way which had just been acquired by the Ohio Department of Highways.

Swinging into a full two-shift schedule by the middle of April, the grading outfit in four months handled 90 per

REVERSIBLE SCREW controlled by machine operator takes concrete discharged from truck mixer and spreads it across subgrade. Spreader and truck mixer move forward in unison during discharge of 2.66-cu.yd. batch.

ON TOP OF MESH REINFORCEMENT. spreader distributes 2-in. top layer of concrete uniformly across slab between edge forms.



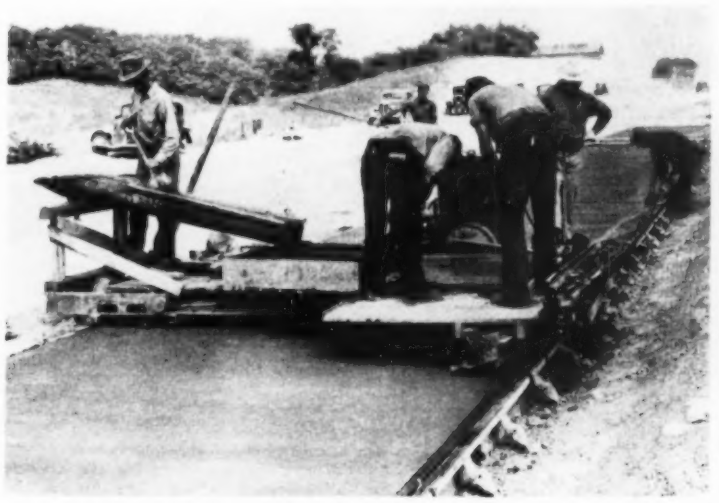
TWO-SCREED FINISHING MACHINE behind spreader carries flexible shaft vibrator unit used to vibrate concrete along edges of slab.

OHIO DEPARTMENT OF HIGHWAYS has strong representation on job when these men assemble for inspection: (Left to right) EDMUND MESLOH, assistant chief engineer of construction; CHARLES M. SPRAGUE, assistant division engineer; F. C. HERRON, assistant engineer; and ROBERT G. JONES, project engineer.

cent of the earth and rock on the job. By July 25, the grade was in shape to permit Hussey & Holderman to start their truck mixers rolling over the east half of the project. Operating on a one-shift basis, the paving outfit placed 6½ mi. of 22-ft. slab in two months, leaving nine weeks in which to dress the project for final acceptance before December 1, one year ahead of contract completion date.

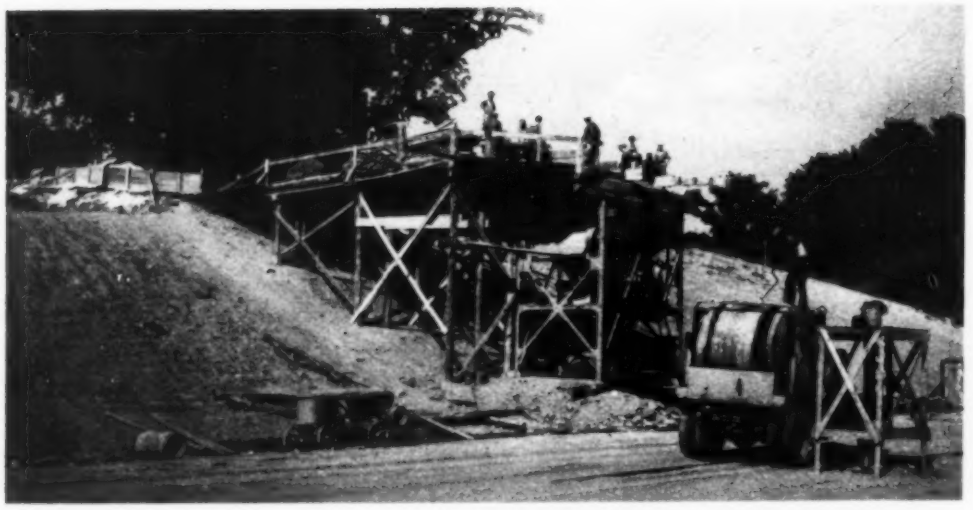
Only one 22-ft. concrete roadway was constructed under the Myers contract, but the grade was built 64 ft. wide throughout the length of the project to provide for a second future roadway of equal width, separated from the first by a 4-ft. median strip. Shoulders are a minimum of 8 ft. wide. The width of the highway grade, in conjunction with im-

FAST GRADING PROGRESS on job is made possible by abundance of equipment and able supervision supplied by RALPH MYERS, contractor.



SELF-PROPELLED CURB MACHINE is equipped with trough and form for banking lip curb concrete against 3-in. curb form.

PAVING PROGRAM proceeds smoothly and rapidly under supervision of JOHN POWELL (left), inspector, and VERNE N. HOLDERMAN, in charge for Hussey & Holderman.



AS TRUCK MIXER drives up to batching plant, it stops at elevated platform to permit workman to open hatch on drum. Cement and aggregates are delivered to batching plant by trucks backing over timber trestle.

SAW-TOOTH KNIFE (right) cuts slots for contraction joints above dowel bars embedded in slab.

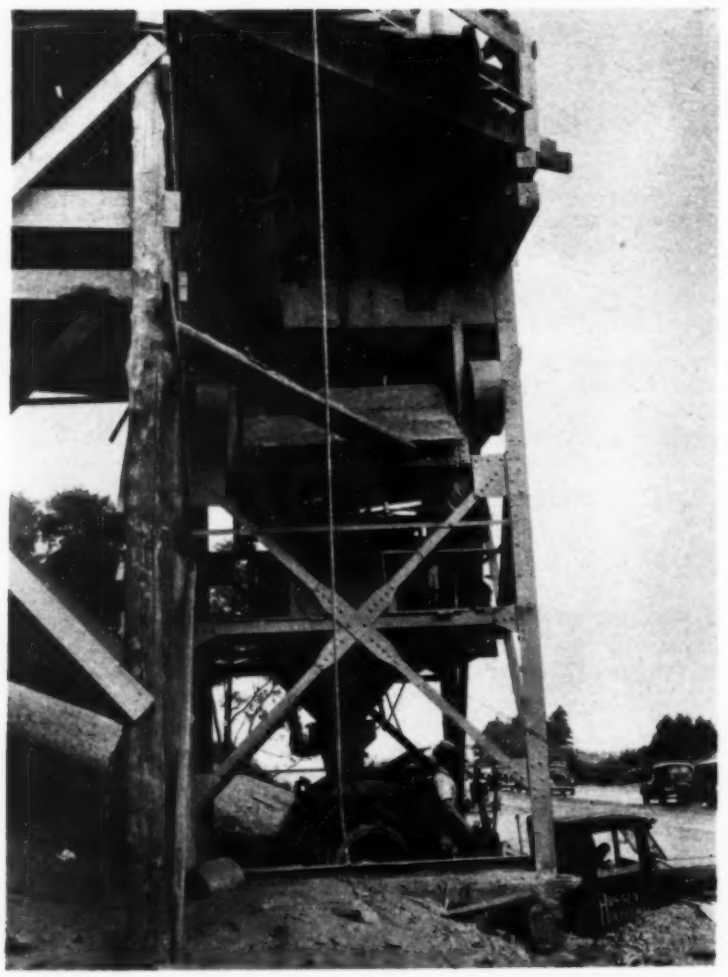
proved alignment and longitudinal profile on the new location, accounts for the 1,200,000 cu.yd. of grading involved in the contract.

With the exception of a few cross-overs, the new location follows the old right-of-way for only 1,300 ft. in the total distance of 6½ mi. Width of right-of-way for the new construction varies from a minimum of 100 ft. to a maximum of more than 400 ft., where high fills required great spread. Fills run up to 65 ft. in height and cuts up to 50 ft. in depth.

Culverts under some fills were constructed with Armco corrugated metal pipe in 30-, 36- and 48-in. diameters. In three of the longer culverts the pipe as placed was strutted

(Continued on page 117)

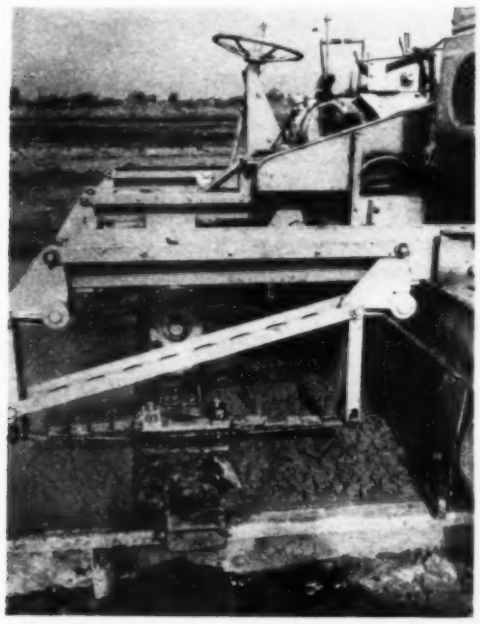
ALL INGREDIENTS of 2.66-cu.yd. batch discharge simultaneously into mixer drum. Total loading time at batching plant, including hatch-off and hatch-on, varies from 60 to 90 sec.



BEAM SCALES weigh three sizes of aggregate drawn from separate compartments of 120-ton bins. Cement, measured out of sacks, passes down spout from platform above.

Spreader-Vibrator

SPEEDS SURFACE FINISHING OF HARSH CONCRETE

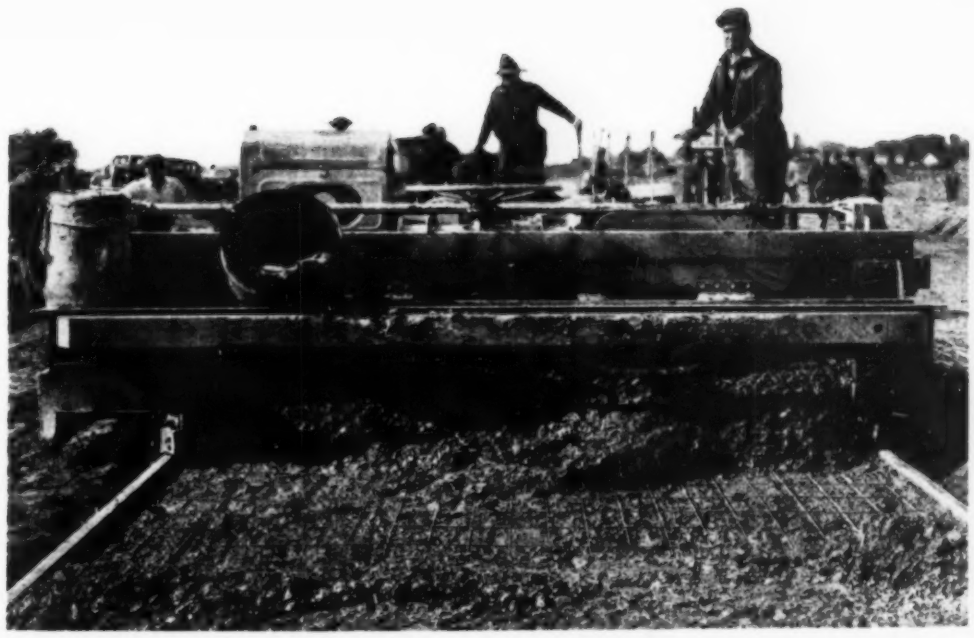


SPRING-SUSPENDED from cantilever arms at rear of spreader, vibrating pan operating at frequency of 4,000 r.p.m. does not touch road forms; full effect of vibration is transmitted to concrete in pavement slab.

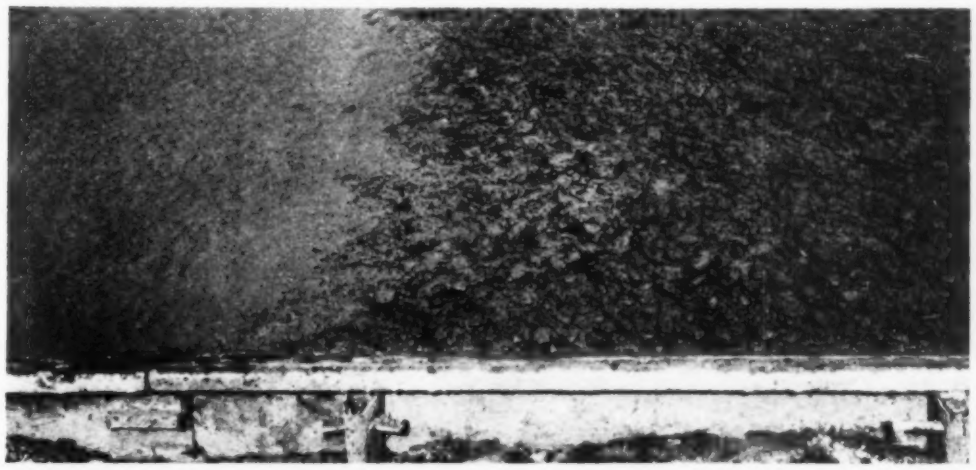
A SPRING-SUSPENDED PAN VIBRATOR attached to the rear of a transverse-blading-type concrete spreader and driven from the spreader's motor-transmission assembly proved a valuable expediter of the finishing operation on harsh gravel concrete, ½- to ¾-in. slump, placed by J. C. O'Connor & Sons, Inc., contractor, Fort Wayne, Ind., in building a section of U. S. 20 at Rolling Prairie for the Indiana State Highway Commission. Supported by leaf springs on cantilever arms at the rear of the spreader, the vibrator attachment, operating at a frequency of 4,000 r.p.m., was controlled by the spreader operator, who could raise the pan or lower it to the pavement surface as desired. Accompanying photographs illustrate the design of the vibrator attachment and the results accomplished with it.

As two of these photographs show, the flexibly suspended vibrator did not come in contact with the road forms, and all the vibration therefore was transmitted to the concrete. Although no supplemental internal vibration was used along the edges of the slab, the edges were found to be free from honeycomb when the forms were stripped. The spreader-vibrator accomplished the

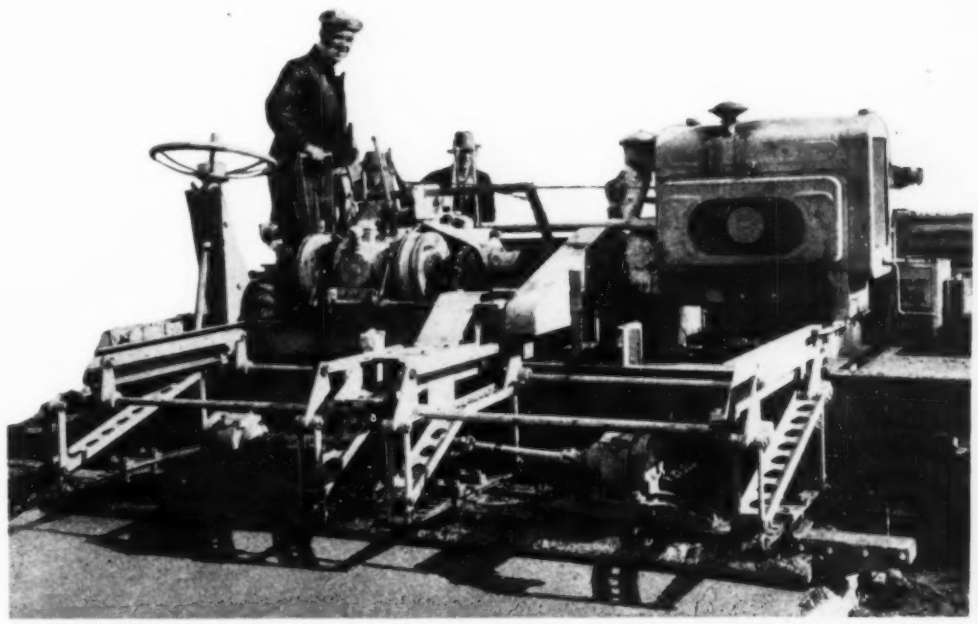
(Continued on page 117)



DRY, HARSH GRAVEL CONCRETE of ½- to ¾-in. slump is placed in two courses in 11-ft. lane on U.S. 20 construction in Indiana, with reinforcing mesh installed on first course 2 in. below final grade. Transverse blading spreaders distribute and strike off concrete for each of two courses. This spreader, on top course, carries rear-end vibrator attachment controlled by spreader operator. Second operator in picture is on finishing machine, which follows closely behind spreader-vibrator.



BEFORE AND AFTER VIBRATING: Coarse surface at right shows texture of concrete which has been spread without vibration, and surface at left indicates compacted, sealed and adequately mortared condition resulting from operation of vibrator attachment in conjunction with spreader.



POWER TAKEOFF from motor-transmission assembly of concrete spreader drives spring-suspended vibrator attached to rear of machine. Vibrator is so designed that it does not come in contact with road forms, thus avoiding danger of form settlement in soft ground as result of vibration.

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Cletracs speed up every operation in dirt moving, bulldozing, loading or shoveling. Their multiple speeds forward and their 2 speeds reverse enable you to shuttle back and forth faster. Cletracs give more production time for push or pull and have less lost time on empty backup or haul back.

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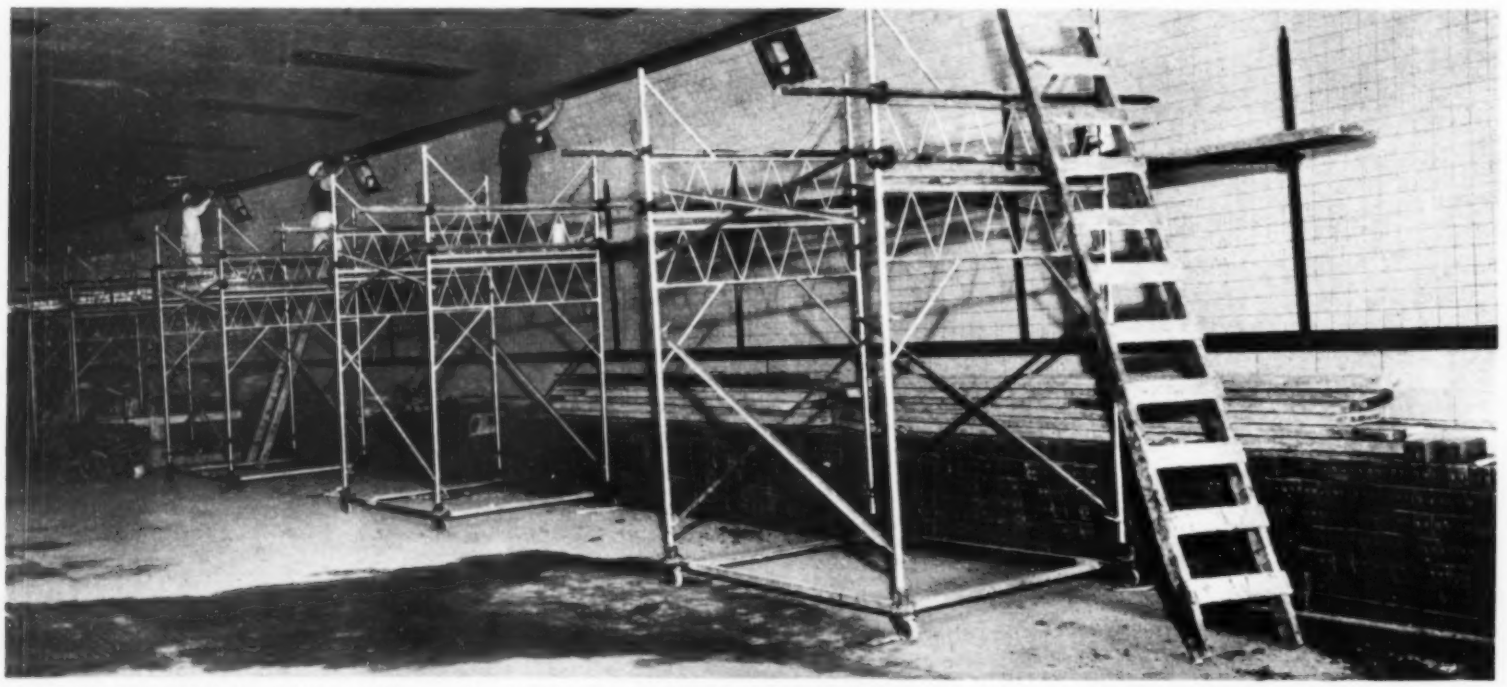
HOW They Did It

CONSTRUCTION DETAILS For Superintendents and Foremen

TOPSOIL SPREADER operated by uphauling and downhauling cables running to winches on two tractors serves J. C. O'Connor & Sons, Inc., Fort Wayne, Ind., in covering bank to which soil must be delivered from foot of slope. Welded steel spreader built under direction of A. D. Blackburn, superintendent, travels on wood rails of same depth as topsoil cover.

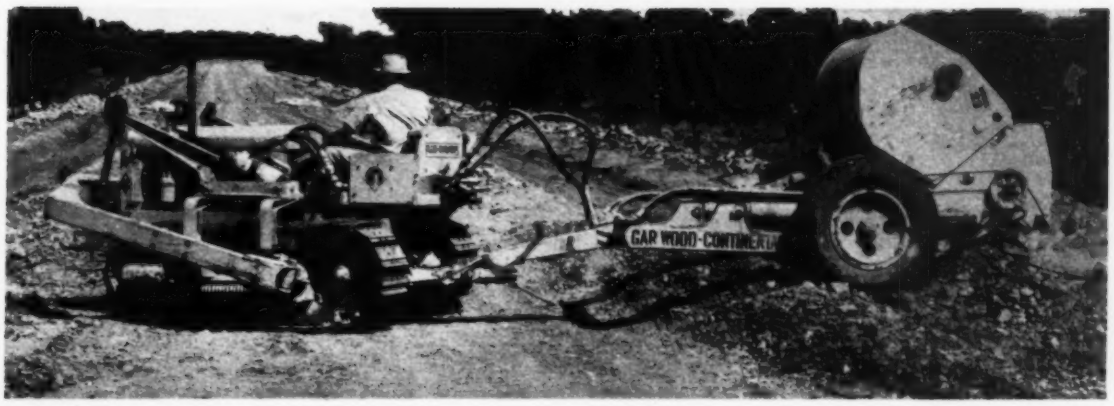
TEETH on dozer attachment of Caterpillar tractor at Prado dam scarify fill surface prior to placement of next layer to increase bond between successive layers. Depth to which teeth penetrate is controlled by setting of two guides or shoes attached to underside of draw beams.

AIR-POWERED MUCKING SHOVEL cleans up excavation in one of Shasta dam grouting and drainage tunnels and casts spoil backward into muck car attached to rear of Eimco-Finlay unit.

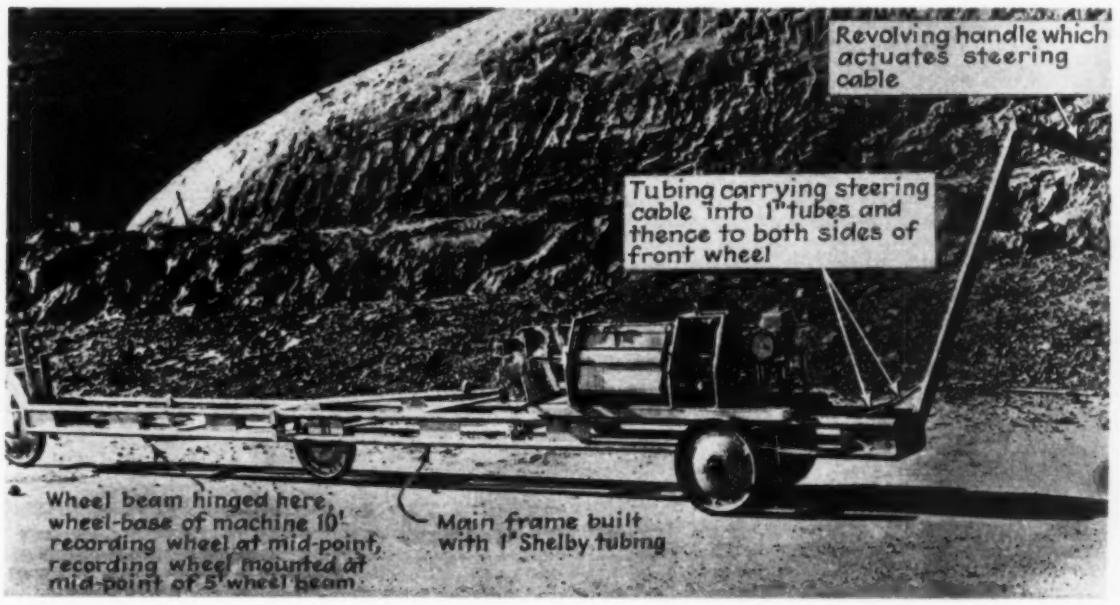


MOVABLE SCAFFOLDING of light tubular construction simplifies work of handling tile setting and other details of interior finish on newly opened Queens-Midtown twin-tube vehicular tunnel under East River between Long Island City and Manhattan, built under direction of New York City Tunnel Authority.

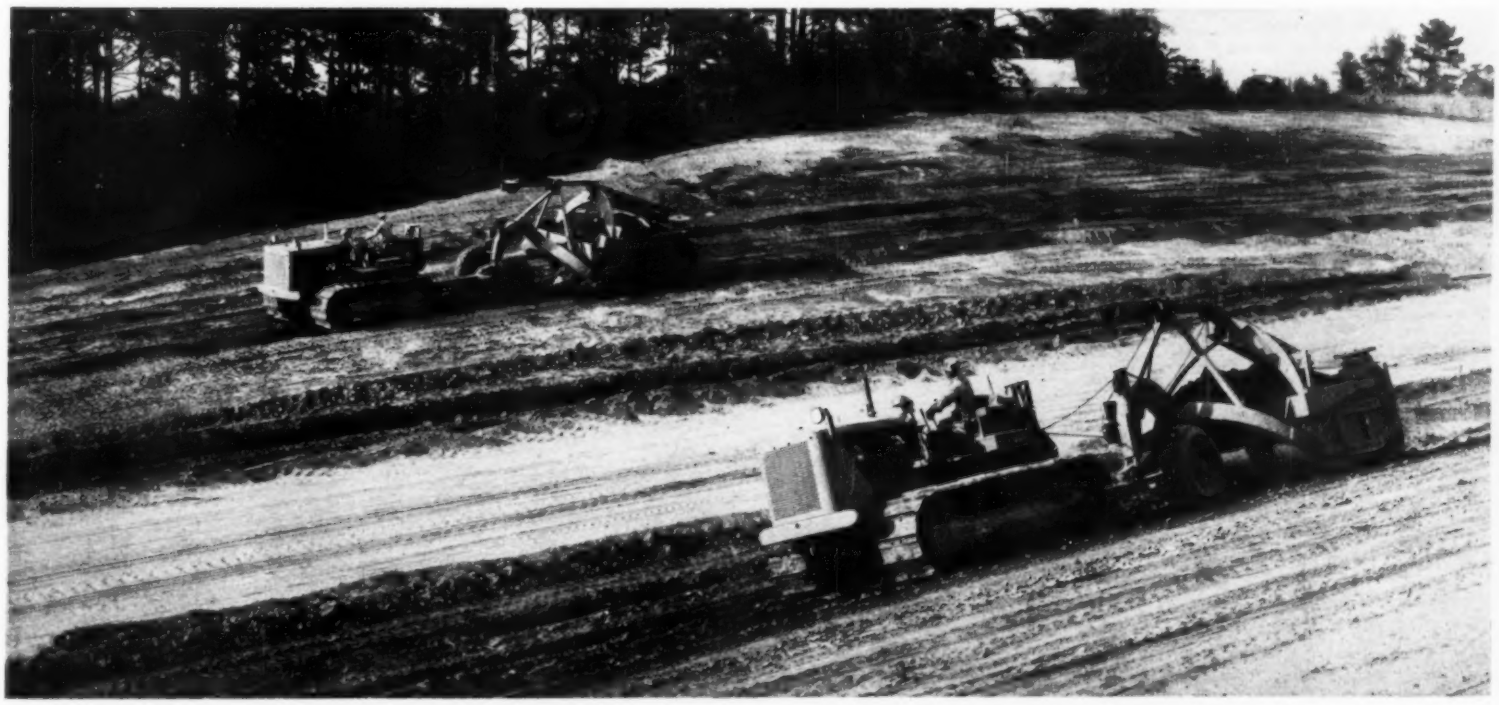
SAFETY TONGS for handling 6x6-in. concrete beams into and out of curing tank prevent smashed fingers, strained backs and possible ruptures, according to Texas Highway Department, which reports successful use of tongs in District 18, Edward F. Maddox, senior resident engineer.



CULVERT BACKFILL on farm-to-market road in Stevens County, Tex., is placed by rear-end dumping with Gar Wood-Continental scraper powered by Allis-Chalmers gasoline scraper which loads bowl with earth and rock in 60 ft. Trailbuilder attachment on tractor is fitted with blade when unit is used to doze hills, level fills or cut ditches and banks.

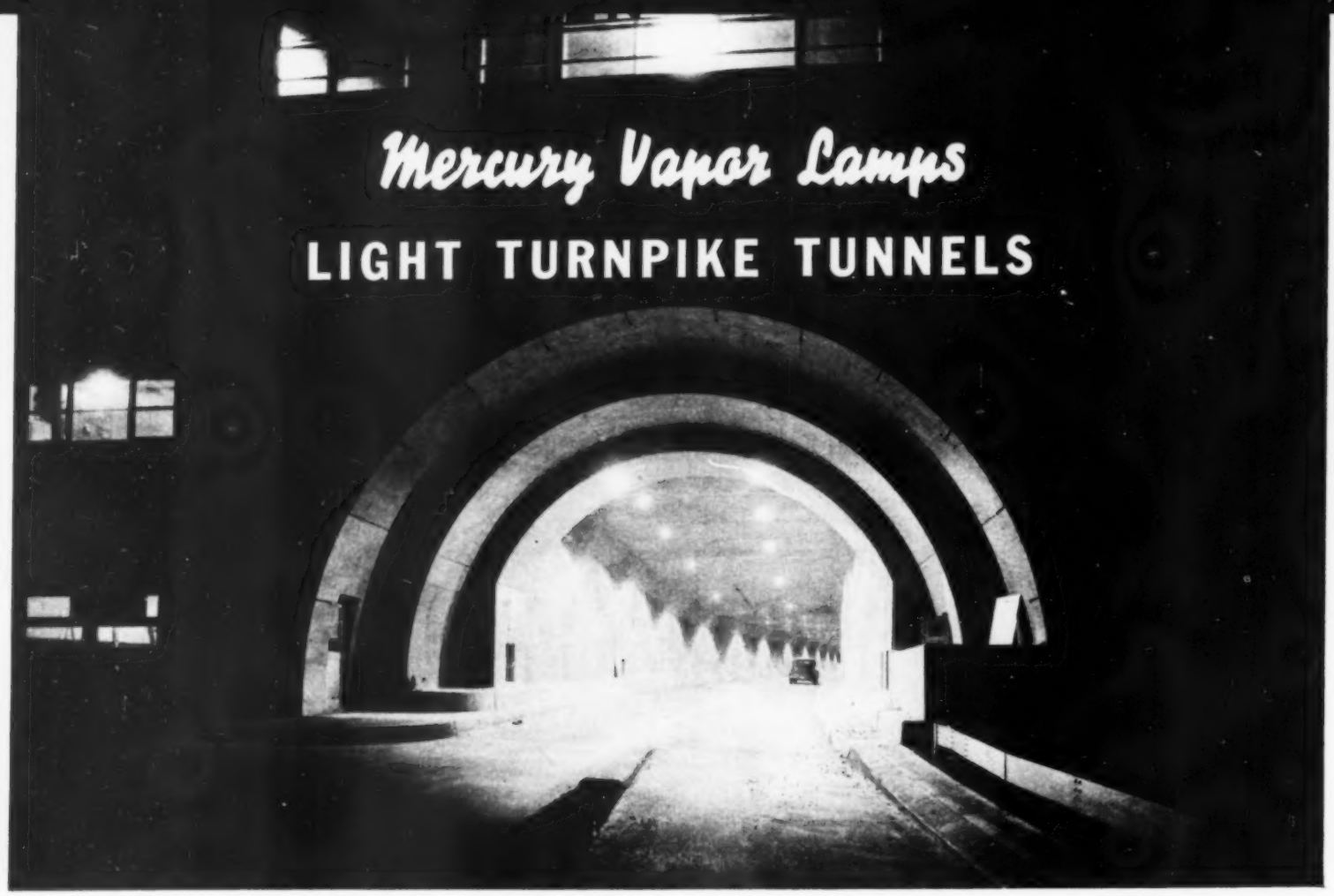

Revolving handle which actuates steering cable
Tubing carrying steering cable into 1" tubes and thence to both sides of front wheel
Wheel beam hinged here; wheel-base of machine 10'. recording wheel at mid-point, recording wheel mounted at mid-point of 5' wheel beam
Main frame built with 1" Shelby tubing

VIAGRAPH, a road surface meter machine developed by California Division of Highways from basic design of Claran F. Galloway, Los Angeles County Road Department, is pushed at walking speed by operator who steers front wheel by means of revolving handle similar to throttle control on motorcycle. In addition to recorder mechanism, apparatus includes odometer and special totalizer to record positive travel of graph pen. When operating, chart progresses 1 in. every 20 ft., and pen moves on 2:1 ratio, i.e., ¼-in. bump is drawn ½ in. high.



BANKSLOPING on Georgia highway job of A. H. Lawler, Gordon, Ga., is handled by Le Tourneau scrapers and Caterpillar 69-hp. diesel tractors. Tractor-scraper units carry average load of 8.5 cu.yd. and make twelve trips per hour on 200-yd. haul to fill.

Mercury Vapor Lamps LIGHT TURNPIKE TUNNELS



AT TUNNEL ENTRANCES motorist is warned by distinctive yellow color of sodium-vapor lighting. Inside tunnel mercury-vapor lights illuminate roadway.

HIGHWAY TUNNEL LIGHTING with mercury-vapor lamps has been used for the first time on the 160-mi., $70,000,000 Pennsylvania Turnpike between Harrisburg and Pittsburgh, opened to traffic Oct. 1, 1940. Seven tunnels, aggregating 6.7 mi. in length, are included in the new superhighway which is studded with more than 1,500 lighting units, including 10,000-lumen sodium-vapor lamps for marking tunnel approaches and traffic interchanges. At tunnel entrances lighting intensities are graded to aid drivers in adjusting their vision.

Lighting the 6.7 mi. of highway tunnel is claimed to be the largest project of its kind ever undertaken. For this purpose 1,060 Westinghouse 250-watt high-intensity mercury-vapor lamps in open reflectors are recessed into tunnel ceilings to provide a lighting system claimed to yield three times as much light output as could be obtained from incandescent sources of the same wattage. Correct distribution of light is obtained by mounting the lamps horizontally with their long axes parallel to the roadway.

Average tunnel illumination is 5½ foot-candles, approxi-

INSIDE TUNNELS (below) mercury-vapor lamps supply three times as much light as incandescent lamps of same wattage. Units are mounted flush with top of tunnel. Intensities taper off from each tunnel portal.

TRAFFIC INTERCHANGES are lighted by sodium-vapor units. On average, 14 units are used for lighting underpasses, curves and turnouts.

mately twice as much as in the Holland vehicular tunnel under the Hudson River, New York City. Illumination intensities are greater at the tunnel ends, tapering from 150 foot-candles at the portals to 5½ at a distance of 250 ft. from the entrance. Tunnel lighting is designed for a driving visibility of more than 1,000 ft.

Sodium Lamps At Tunnel Approaches

Tunnel approach lighting extends an average of 1,800 ft. out from the tunnel portals and employs the Westinghouse sodium-vapor "butterfly" luminaires. Sodium-vapor lamps are used because they provide a good seeing light, but, more important, because their yellow color acts as a caution signal to the night driver.

Lighting units at tunnel approaches are suspended from overhanging arms mounted on wood and steel poles. Units hang 25 ft. above the roadway and extend about 6 ft. over the edge of the concrete pavement. To lessen contrast between the bright tunnel lighting and the comparatively dim illumination provided by the car's headlights as it leaves the tunnel, units are spaced at gradually increasing intervals, from 125 to 350 ft., progressing away from the tunnel portal. Such spacing also gives the reverse effect of gradually increasing light intensity for the motorist approaching the tunnel entrance.

Unlike that of the tunnels and their approaches, where high lighting intensities make the use of headlights unnecessary, traffic interchange illumination is designed only for cautioning the approaching motorist. The yellow sodium-vapor lamps, because of their distinctive color, are used here, too. They are located at the strategic points of the interchanges — at turnouts, on curves, and on underpasses of lanes where caution signals are desirable. For interchange lighting 151 sodium units are used, an average of 14 per interchange.

An emergency lighting system, operat-

(Continued on page 116)

"BUTTERFLY" LUMINAIRE using sodium vapor, of which there are 321 in service, is employed for lighting tunnel approaches and traffic interchanges.

RING IN CEILING SLAB (below) of tunnel holds in place mercury-vapor lighting units.

AT TOLL GATES (below) outside areas under marquee covering driving spaces, illumination is by incandescent lights, mounted flush in marquee ceiling. Ticket office interiors are equipped with fluorescent lamps.

KENTUCKY PROJECT TESTS

Varied Cements and Dust-Coat Surface Coloring

34E TWIN-BATCH PAVER mixes 36-cu.ft. batches for third-lane experimental sections, placed along side completed 22-ft. pavement.

DUST COAT MIXTURE of red highway iron and portland cement is made up in wheelbarrow on job.

HAND SCATTERING spreads dust coat on surface of freshly finished slab. Two pails of dry mixture cover 20 lin. ft.

LONG-HANDLED FLOATS work dust coat into finish mortar, coloring concrete surface to depth of about 1/16 in.

AFTER RED TOPPING (below) has been floated in, surface of slab is broomed. Finishers in background work dust coat into lip curb.

FOR THE DUAL PURPOSE of testing the effects of various cements upon the durability of concrete pavement and the practical utility of thin red topping as a permanent surface color, the Kentucky Department of Highways laid a series of experimental sections in a 5-mi. stretch of third lane on a 9-mi. paving job recently completed by F. C. Gorrell & Sons, Russellville, Ky. The project relocates U. S. 31W on improved alignment and grade through the hills bordering the Ohio River Valley, and the highway passes close to the famous gold vault on the Fort Knox Military Reservation, about 20 mi. south of Louisville. Portland cement in standard and modified varieties (the latter with vinsol resin added) was used in some sections of the experimental lane, and in certain cases was blended with natural cement manufactured in two varieties, with and without the addition of a grinding aid. On several sections, the slab surface was colored by a thin topping of red metallic hardener and ce-

INTERESTED OBSERVERS of work on experimental sections are L. J. PARRISH (left), assistant district engineer, and ROY L. GORRELL, of F. C. Gorrell & Sons.

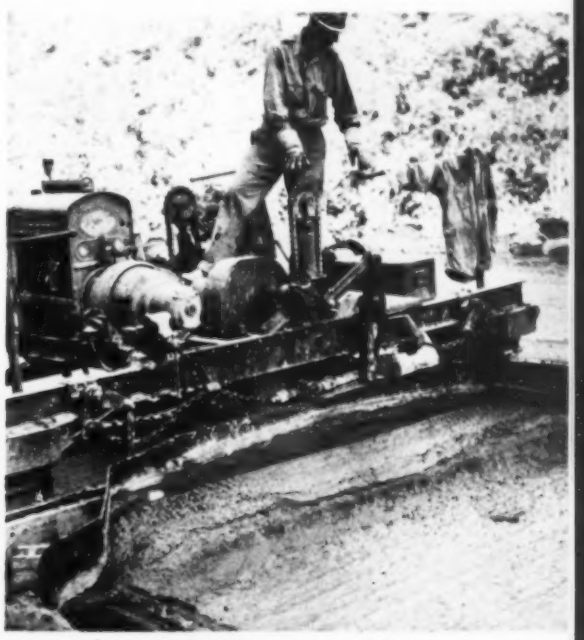
ment, dusted on and floated into the concrete. All concrete on the job was mixed by a 34E dual-drum paver, and the paving crew working with this machine made good progress both on the 9 mi. of 22-ft. slab completed first and on the 5 mi. of 11-ft. lane placed later.

Kentucky's investigations of the special cements and cement blends will provide data on a subject now under intense study and experiment in a number of states, viz: What is the value of these cements in preventing scale and adding durability to concrete pavement? The Kentucky experiments embody certain modifications of test methods followed in other states, but they pursue the same objective of determining from field service records, as well as laboratory tests, the durability of concrete pavement made with standard, altered and blended cements.

(Continued on page 72)

ROCK CUT 105 FT. DEEP features relocation of U. S. 31W through hills bordering Ohio Valley, in background, from which highway ascends on maximum 6½ per cent upgrade to high land of Ft. Knox Military Reservation.

VINSOL RESIN GROUND PORTLAND CEMENT is used in this concrete, dumped on subgrade paper. Strike-off has been pulled ahead to permit placing form for box inlet at left.



ROLL OF FINISH MORTAR in front of screed is unusually heavy for second pass of finishing machine, but consistency of mortar gives some suggestion of workability produced with vinsol resin ground portland cement.

ON 6½ PER CENT GRADE. passage of finishing machine leaves slightly undulated surface on concrete. This section contains vinsol resin ground portland cement.

MECHANICAL LONGITUDINAL FLOAT (below) follows finishing machine and works out transverse corrugations in vinsol resin ground portland cement concrete on 6½ per cent grade.

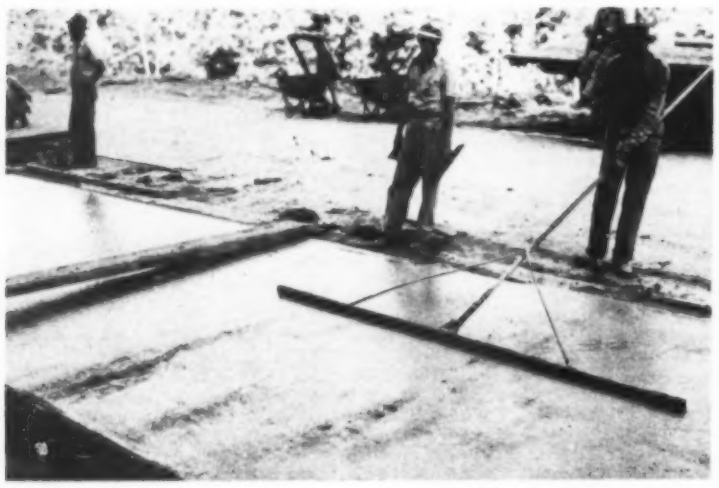
TRAIN OF PAVING EQUIPMENT behind mixer includes strike-off, finishing machine and longitudinal float. Note dark color of slab in background, where red dust coat has been applied.

As to surface coloring by the dust-coat method on a concrete highway, the Kentucky experiment is believed to be the first of this kind. Tennessee has successfully colored concrete pavement by incorporating iron oxide as an ingredient in the mixture, and a red lane thus colored in that state has given continuing satisfactory service as a traffic guide during the last year. So far as is known, the Kentucky job is the first to attempt surface coloration by floating a dust-coat of metallic hardener, iron oxide and portland cement into the fresh concrete, duplicating a method successfully employed in applying colored metallic hardener to concrete floors of buildings and driveways of service stations.

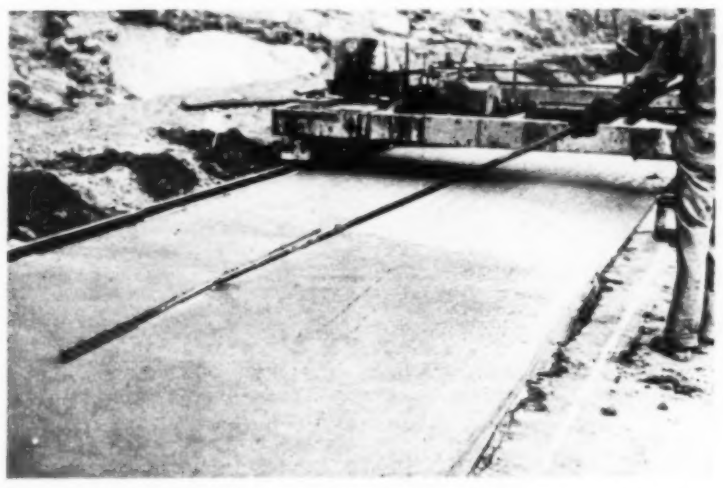
Purpose of Red Color—Color was added to the surface of the third lane for a distance of almost 10,000 ft., much of this distance being on a long grade extending from the valley floor to the higher elevation of Fort Knox. Included in this climb is about 1,200 ft. of 6½ per cent grade on tangent which slices through a rock cut measuring 105 ft. deep on the high side. The third lane is the righthand lane for ascending traffic, and the color is intended to mark the lane unmistakably for use by slow-moving vehicles climbing the grade, leaving the other two lanes clear for normal traffic flow in both directions. Tennessee's experiment, involving a red third lane on a similar grade, has demonstrated the effectiveness of the distinctive coloring.

Test Sections—Comparative tests of concrete durability and resistance to scale are being made throughout the length of the third lane, including the portion colored red. For the purpose of testing the various cements, the lane was divided into seven large-scale sections ranging in length from 3,300 ft. to nearly 1 mi. Starting at the north end of the job, in the valley, where the new location branches off from the old

(Continued on page 86)



TENDENCY TO TEAR causes some difficulty for straight-edge operator when he first starts to work on vinsol resin ground portland cement section. This photograph illustrates extreme case of surface tearing.



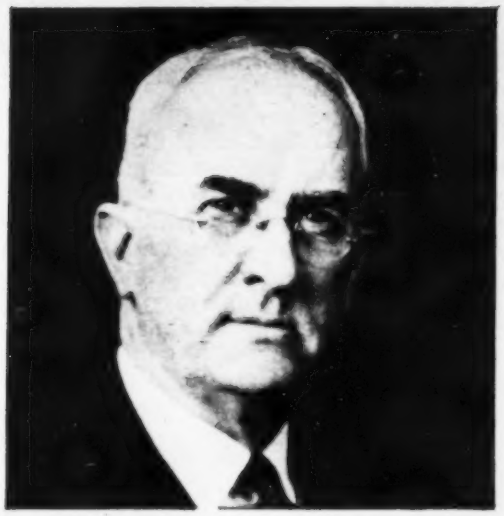
AFTER BRIEF EXPERIENCE, straight-edging proves easier on vinsol resin ground portland cement concrete.

KENTUCKY PAVING PROJECT, including experimental sections, is built under direction of: (Left to right) E. A. SMOTHERS, paving inspector; F. L. ANTHONY, assistant resident engineer; F. PAUL ANDERSON, II, research engineer; DEWEY SPARKS, resident engineer; and BROWNING GORRELL, superintendent and member of F. C. Gorrell & Sons, contractors.

WITH RED COLOR FLOATED IN, surface of vinsol resin ground portland cement concrete is broomed.

Present and Accounted For

A PAGE OF PERSONALITIES



NEW PRESIDENT of American Society of Civil Engineers is FREDERICK H. FOWLER, consulting engineer, of San Francisco, Calif., and former director of society (1928-30), who took office during eighty-eighth annual meeting in New York City, Jan. 15-18. A graduate of Stanford University (1905) Mr. Fowler, since 1922, has maintained an engineering practice dealing mainly with problems of dam design, flood protection, hydro-electric power development and water supply. He was president of society's San Francisco section in 1939.

NEW ENGLAND ROAD BUILDERS gather at fall meeting of association. Among those present were, (left to right): JOHN W. BEAL, commissioner, Massachusetts Department of Public Works; FREDERIC E. EVERETT, commissioner, New Hampshire State Highway Department; OVID F. WINSLOW, president, New England Road Builders' Association; FREDERICK V. WATERMAN, director, Rhode Island Department of Public Works.

NEW DIRECTOR of Ohio Department of Highways is HAL G. SOURS, formerly acting director and chief engineer, recently appointed to fill vacancy created by resignation of Maj. Gen. Robert S. Beightler, now in command of Ohio National Guard.

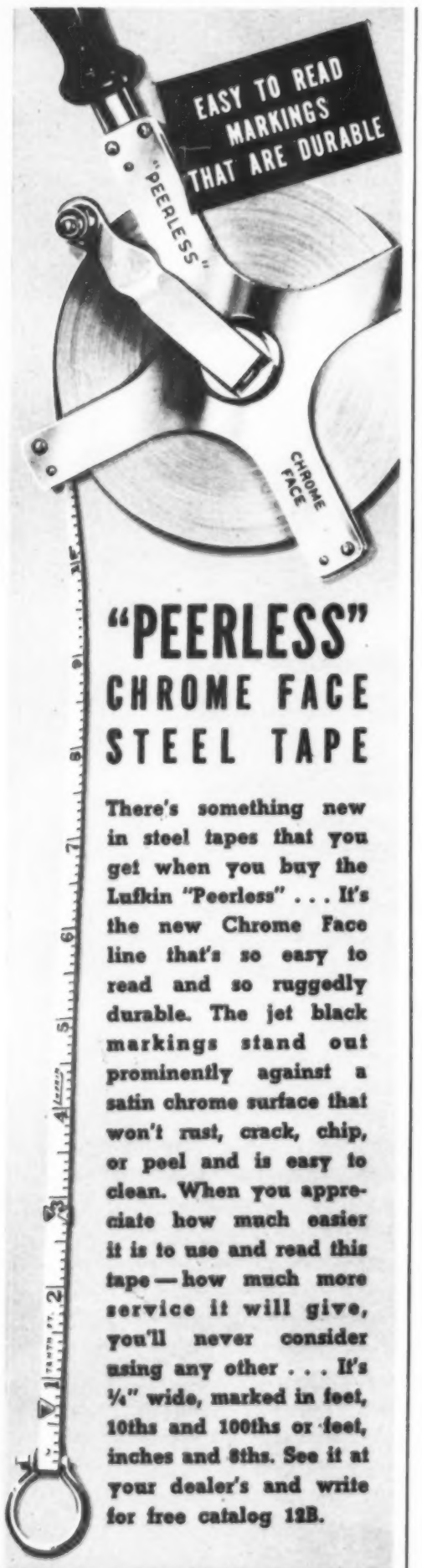
CONSTRUCTION ENGINEER for Montana State Highway Department is D. L. CHENEY, recently promoted from position of bituminous engineer. He has served with department since 1928.

SERVING AS PRESIDENT of American Association of State Highway Officials is J. S. WILLIAMSON, state highway engineer of South Carolina. Mr. Williamson was elected at association's annual convention in Seattle, Wash., last fall.

NEW ENGINEER-SECRETARY of National Paving Brick Association is WILLIAM H. CULLIMORE who fills post vacated by death last year of George F. Schlesinger. Mr. Cullimore was formerly associate engineer in Department of Public Works, Baltimore, Md.

STATE HIGHWAY ENGINEER OF TEXAS is DeWITT C. GREER, who succeeded Julian Montgomery, resigned because of ill health. Mr. Greer has served with department as division engineer and as chief of construction and design.

DIRECTOR OF HIGHWAYS of State of Idaho is C. P. HUMPHREY, succeeding H. R. Flint who resigned to join R. M. Hardesty Mfg. Co. Joining department in 1919 Mr. Humphrey has served as draftsman, resident engineer, location engineer, bituminous engineer and district engineer.



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Military Access Roads

(Continued from page 44)

inary estimates of the mileage and cost of new roads and improvements that apparently would be needed. Some of the work resulting from this planning is now in progress as a result of the prompt action of highway departments in several states.

The earlier effort was handicapped, however, by the indefiniteness of the country's defense plans. Later, the national defense program began taking shape. Congress determined the number of men to be given military training, and the schedule has been arranged for moving these men into the military and naval reservations. The War and Navy Departments have located new cantonments, bases, and tactical areas. The National Defense Commission and its advisory council was created and has determined the location of several of the new arms and munitions factories. The Work Projects Administration has been authorized to help finance construction and improvements useful in national defense.

The Federal Highway Act of 1940 permits the use of federal road funds to pay engineering costs of the surveys, plans, specifications, estimates and supervision of construction of urgent improvements of strategically important highways upon request of the Secretary of War, the Secretary of the Navy or other authorized defense agency. The act also authorizes the Commissioner of Public Roads to give priority of approval to federal-aid projects for road construction recommended by authorized defense agencies as important to the national defense.

With access-road requirements more definitely but not yet fully outlined and with at least some of the money provided for building them, the final planning could begin. The Public Roads Administration and the Work Projects Administration cooperated with the War Department in organizing formal conferences throughout the country to determine the specific access roads and streets needed at the site of each military establishment and defense industry, the approximate cost of these improvements, and the money available from different federal, state, and local agencies for construction. These conferences are being held at the various military reservations. Those participating include representatives of the corps area commander, post commander, state highway department, and state Work Projects Administration, county or city authorities that may be involved in the planning, and the district engineer of the Public Roads Administration.

Typical Demands For New Roads

The construction job is a big one. New defense industries, and old ones that are expanding, are in immediate need of road improvements. A new shell-loading plant in the Middle West, for example, apparently will require about 15 mi. of road costing close to $500,000.

An established airplane factory in the East is expanding so rapidly that there is some uncertainty as to just how many miles of road improvements it will finally need. It had about 6,000 employees at the time the defense program was launched. Since then the personnel of the plant has more than doubled, and indications are that it will almost triple again in the near future, jumping to more than six times the size of the original staff. With each increase in personnel the output of the factory is stepped up and the little city of employees and their families becomes a bigger city. The whole development creates an increasingly greater demand for improved road facilities.

The U. S. Army alone has 130 cantonments and other military establishments throughout the country for which approach roads and streets must be planned. Some of them have been occupied only by skeleton forces, or not at all, for 20 years. Some are newly created. Many are expanding from a personnel of a few hundred men to as many as perhaps 80,000. Some of them will be used for training mechanized troops.

The following scattered examples of preliminary estimates of access-road requirements give some idea of the extent of the work at many of the military sites:

For a naval air station and a nearby army camp with a total personnel of about 50,000, the road needs were figured at 50 mi. of new construction, costing probably $2,000,000. More than 40 mi. of this road were included in the plans for the camp, which has sprung up on the prairies in the last year. The additional 10 mi. would be used by both establishments.

Another army camp for training about 40,000 mechanized troops apparently will require more than 50 mi. of road of the first order of importance, at an estimated cost of more than $3,250,000. Another 18 mi. is considered desirable for military purposes, and would cost nearly $750,000. About 35 mi. more, at an estimated cost of nearly $1,500,000, would be of value at some future time, but is not now of an emergency character.

The road needs of a naval air station with a personnel of 10,000 men and with several auxiliary fields in the vicinity have been estimated to include 30 mi. of vital road at a cost of more than $2,000,000, and about 10 mi. of other road which could be temporarily deferred, costing probably more than $500,000.

In planning access road and street facilities for military reservations one of the big difficulties of the conferences is in determining the traffic capacity that will be needed. Many camps are expanding from a personnel of a few hundred men to as many as 78,000. Some of them will be used for training mechanized troops.

Investigations by Public Roads Administration indicate that road requirements of camps that are similar in type and size may differ considerably. The distance to the nearest large city, the distribution of

(Continued on page 76)

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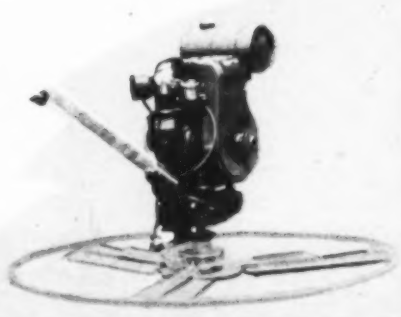

(Continued from page 74)

the civil population in the general area, the presence or absence of direct rail connection with the camp—these are some of the factors, in addition to the size and type of camp, that determine the volume of motor-vehicle traffic in and around a military establishment.

Very preliminary findings hint at a decided difference between the traffic on roads in and around military centers and that on the main highways. Civilian traffic shows a gradually increasing volume from Monday through Friday, a considerable increase on Saturday, and a sharp increase on Sunday. The volume of traffic in military areas, on the other hand, apparently continues at a high level from Monday through Friday, with a marked decrease over the week end.

In addition to the planning of immediate accesses to the military camps, the planning conferences are also giving attention to main highways in the vicinity of camps where the traffic flow will be complicated by the movement of army convoys in regular maneuvers. On a narrow, two-lane road a convoy may cause more congestion than perhaps several thousand cars.

Public Roads Administration engineers are observing the effect of different spacings between the vehicles in army convoys on the flow of civilian traffic around them. Studies of troop movements last spring convinced highway officials and the War Department of the value of wider shoulders—8- to 10-ft. widths—in alleviating traffic congestion by troop trains. The findings of the engineers should be helpful in meeting the problem of military traffic on certain main highways.

The expansion of some of the army camps has created an added problem of relocating existing highways or providing adequate highway grade-separation structures. Fort Lewis, Washington, is an example. It is located on one side of U.S. 99, a four-lane road with a traffic volume of about 5,000 vehicles a day. A railroad parallels the highway. The fort is now expanding on land on the opposite side of the two routes. The question is under consideration of relocating the highway or of building grade separations to give the Army free access between the two parts of the reservation.

In many areas the problem will not be simply to provide an access road for the use of a military camp, or one for the use of a defense industry. Instead, the job will be to provide roads for the combined use of perhaps one or more army reservations or navy bases, and also possibly heavy industries located in the same area. An outstanding instance of this sort is the Hampton Roads area in Virginia.

The construction of access roads is definitely the No. 1 highway job at the present time. However there has been no lessening of the importance of conditioning the main highways that have been designated as the strategic system. This conditioning work should be done as rapidly as possible. As revised by the War Department in October, 1940, the strategic system now totals 75,000 mi., nearly

(Continued on page 78)

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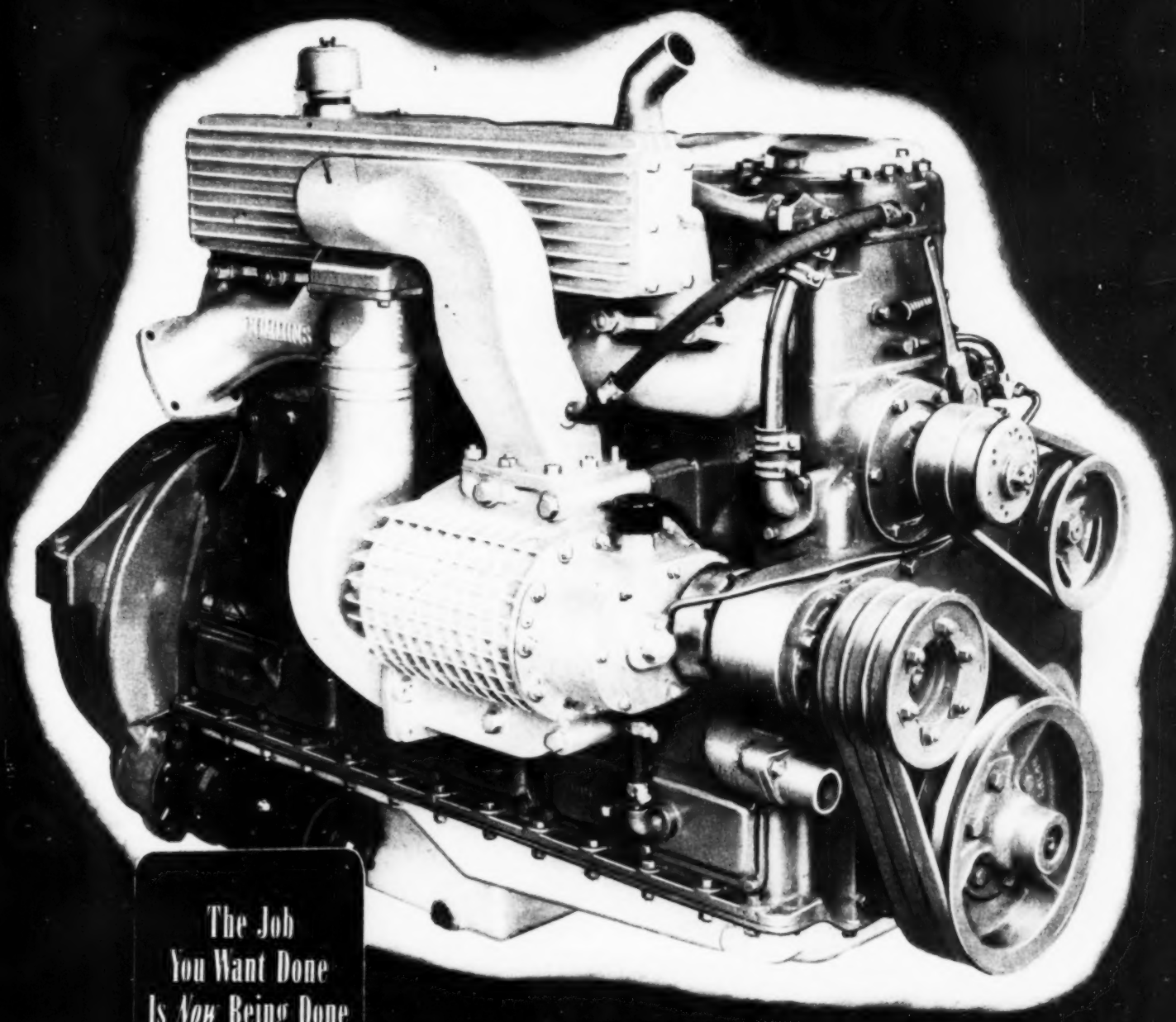

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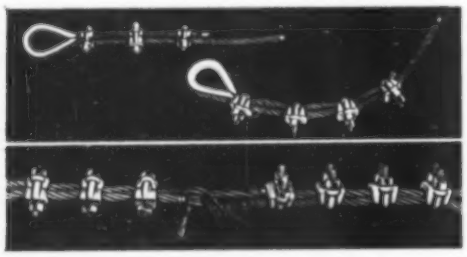

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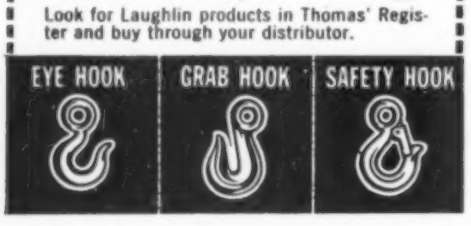

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all of which coincides with the more extensive federal-aid highway system.

Main Weaknesses Revealed

The highway planning surveys that are being conducted by the state highway departments show where improvements are needed to bring this mileage up to modern standards. These are the main weaknesses revealed:

4,000 mi. of the strategic system are less than 18 ft. in width.

14,000 mi. are deficient in surface strength.

2,400 bridges fall below the H-15 standard of strength.

500 additional bridges do not meet the 18-ft. standard of width or the 12½-ft. standard of clearance, or are deficient in both respects.

The strategic system has only one additional weakness from a military standpoint. In greater part the shoulders are not of sufficient width to meet military requirements. The War Department desires continuous 10-ft. shoulders. Where this is not feasible, the wider shoulders may be built in 2,000-ft. strips at least every 2 miles on alternate sides of the road.

Aside from the need for wider shoulders, military requirements on the strategic system are identical with commercial standards. For years the Army has been designing its equipment for the highways in keeping with peace-time standards of highway construction. The standard H-15 bridges, for example, are strong enough for all classes of military equipment, including tanks up to 50 tons, provided they are spaced at least 50 ft. apart and slowed down to 4 m.p.h.

* * *

NEWS FROM MANUFACTURERS

About Their Products

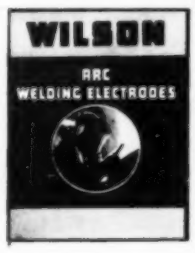
The publications reviewed below, will keep you posted on latest developments in construction equipment and materials available for your use

ELECTROFORGED STEEL GRATING AND STAIR TREADS—**Blaw-Knox Co.,** Pittsburgh, Pa. (24 pp. illustrated, color). Section of booklet devoted to description of method of manufacturing this product. Also portrays micrographic analysis of forged structures of grating. Illustrates diverse range of uses, applying to many industries, and contains a table of safe loads and size variations.

* * *

WHEEL-MOUNTED CRANE — **The General Excavator Co.,** Marion Ohio. (12 pp., illustrated). New machine described in word-and-picture stories with chapters headed "Lifting Capacity," "Mobility," "Maneuverability," and "Stability." Essential facts under each heading are summed up in condensed "Quickfact Summaries." Called "The General Supercrane," machine is integrated, engineered unit with one operator, engine, cab, and set of controls. Travel speeds range up to 10 m.p.h. Rated at ¾-yd. capacity. Load ratings of 5,000 lb. at 50-ft. radius in 360-deg. "full circle" operation. Unit shown in typical operations as crane, clamshell, dragline, pull-shovel and piledriver.

ARC-WELDING ELECTRODES — **Wilson Welder & Metals Co., Inc.,** 60 E. 42nd St., New York City (24 pp., illustrated.) Reviews general description, application, procedure for use and physical properties of Wilson electrodes for numerous and varied welding purposes. Subjects discussed: flat, vertical or over-welding, single and multiple pass all-position welding, horizontal fillet and butt welding of mild steel; general purpose all-position welding with a.c. transformers; all-position welding of carbon molybdenum and low alloy high-tensile steels; horizontal fillet and butt welding of low alloy high-tensile steels; all-position welding of cast iron. Suggestions on selection of proper electrodes for other types of welding. Final section of booklet devoted to "Welding Symbols and Instruction for Their Use," as published by the American Welding Society.



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CALCIUM CHLORIDE—**Solvay Sales Corp.,** 40 Rector St., New York City. (21 pp., illustrated.) New booklet entitled, "End Dust and Weeds", explains use of calcium chloride in laying dust rising from tennis courts, driveways, walks and other unpaved areas. Includes information on quantities to use per square yard of surface treated and describes advantages of calcium chloride treatment for large as well as small areas. Photographs illustrate uses of chemical on projects ranging from paths to playgrounds, from parking spaces to roads.

* * *

PUMPCRETE PRACTICE—**Chain Belt Co.,** Milwaukee, Wis. (92 pp., illustrated.) Based on extensive study of field operations, this book deals with placement of concrete, by pumping through pipe lines, on construction jobs involving at least 1,000 cu.yd. of concrete. Illustrated with photos and schematic drawings of typical and unusual plant layouts for range of jobs which include bridges, viaducts, buildings, sewage plants, locks and dams, tunnels and other structures. Comparisons of various methods and costs of placing concrete. Also data on distribution methods, concrete mixes, mixing plants and other subjects necessary in figuring a concrete job. Reprints from construction magazines of articles on concrete placement.

* * *

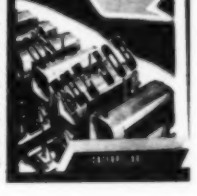
PRACTICAL LESSONS IN ARC WELDING — **The Hobart Brothers Co.,** Box EW-6S, Troy, Ohio (98 pp. and cover). Contents of this book, which sells for 50 cents, is taken from Part 2 of the large Hobart book, "Arc Welding and How to Use It," a volume designed for use of engineers, welding operators, students, executives, supervisors, designers and others interested in welding or in any branch of electrical, mechanical or metal working industries. Subjects treated: (1) Instruction; (2) manipulation; (3) welding with bare electrodes; (4) welding and cutting with coated electrodes; (5) welding light-gage steel.

* * *

ANTI-FRICTION BEARINGS—**Link Belt Co.,** 307 N. Michigan Ave., Chicago, Ill. (12-p. illustrated 8½x4 in.) Presenting humanization of five types of bearing units by comparing them with prize fighters and reclassifying groups according to various weights of pugilists known to ring. New classifications decided: Flyweight for Series 100; welterweight for series 400; middleweight, series 500; heavyweight, series 600; alternate heavyweight, series 7,200. Whole line will be known as "Friction Fighter Bearings."

* * *

DIESEL ENGINES — **Caterpillar Tractor Co.,** Peoria, Ill. (32 pp., illustrated.) More than one hundred typical installations of these power units are photographed and discussed in this booklet, entitled "On the Job," which includes twenty specific classifications and dozens of miscellaneous installations selected to give a broad outline of the general adaptability of the diesel engine. Last seven pages are devoted to miscellaneous jobs being handled by diesel power, featuring shovels, cranes, draglines, dredges and asphalt plants.



EARTH MOVING COST CALCULATORS — **R. G. LeTourneau, Inc.,** Peoria, Ill. For rapid computation of probable production for cost estimates and analyses, Field Engineering Dept. has prepared slide rule calculator based on exhaustive time studies and compilation of extensive job data. This calculator enables earth-movers to estimate probable performance by LeTourneau Carryall scrapers powered by Caterpillar tractors. Production may be computed over any grade or haul distance and provision is made for average speeds as great as 40 m.p.h. Available free of charge from all LeTourneau and Caterpillar dealers or by writing to manufacturer of equipment.

* * *

Asphalt Seal PREVENTS MOISTURE CHANGES

(Continued from page 59)

Houston, applied the hot asphalt on all three jobs, sealing the subgrade with 1¼ gal. per square yard of 90 penetration asphalt to a width of 24 ft., 1 ft. beyond the edge of the slab, and treating the shoulders 9 to 15 ft. wide with 1 gal. per square yard applied at subgrade elevation, this application overlapping the outer 1 ft. of subgrade seal.

Designed to eliminate so far as possible any bulking or shrinking of the subgrade soil caused by fluctuation of the moisture content, the procedure makes use of the asphaltic membrane to prevent any moisture loss by evaporation and places the membrane on soil which has been wetted to capillary capacity as a means of averting further absorption of any appreciable amount of moisture by capillarity. With its moisture content stabilized in this way, the clay soil subgrade is expected to remain effectively protected against volume changes which would affect the smooth riding quality of the concrete pavement.

Asphalt of Texas OA-90 specification (90 penetration) was used for all subgrade and shoulder membrane. Before concrete pavement or shoulder material was placed, the asphalt was covered with sand at the rate of 1 cu.yd. to 50 sq.yd. The distributor was not allowed to operate on the subgrade but was required to apply the asphalt from the side of the completed work. In other words, that part under the concrete slab had to be shot from the shoulder, and the shoulder had to be shot from the completed slab. To start the application in April, while the weather was still cool, the contractor designed a special outrigger equipped with a large heated pipe, as shown by a photograph. The hard asphalt would have clogged an ordinary offset bar and piping in cool weather.

Construction Procedure

After subgrading had been completed between the steel forms for the concrete pavement, the forms were removed, and

(Continued on page 80)

Do you want BIGGER YARDAGE with ¾ yard shovels?

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HEAVY DUTY CONSTRUCTION

The field-proved BAY CITY design from crawlers to boom point, combines *heavy duty construction* with the modern use of alloy steels to reduce unnecessary dead-weight, yet retaining the stamina and strength so desirable for long, continuous, low-cost service. Look over the specifications of any BAY CITY machine and you will find the same sound principle of construction, whether it be a ⅜ or a 1¼ yard rig. Nothing has been sacrificed in the way of sturdy design as our business has been built by offering BIG MACHINE VALUE in SMALL SHOVELS. That is why more machine owners are switching over to the fast, powerful, easy operating BAY CITY.

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Extra power with big 6 cyl. gasoline engine — 78 HP@1200 RPM

Heavy structural crawler frame with drop forged alloy steel heat treated shoes — chain driven through specially hardened sprockets which are bronze bushed and have outboard bearing support.

Unit-cast alloy steel bases for lower carbody and revolving table eliminates deadweight yet retains the strength of one-piece steel castings. Large diameter tapered roller path with internal ring gear.

Anti-friction bearings throughout, even to boom point sheave to reduce power loss to minimum.

"E-Z" control booster actuated clutches with finger tip touch giving operator "feel" of the load.

Sturdy all electric welded box-type boom and straddle dipper sticks. Full ¾ yd. (line of plate) bucket having cast manganese front and cast back.

Powerful one-piece chain crowd that is positive and independent, giving wider working ranges and reducing maintenance costs.

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Travel speed—¾ MPH low—1¾ MPH High
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Crowd out speed—70′ per min.
Reverse crowd—140′ per min.

Shovel working ranges with standard 19′ boom, 14′ sticks at 45°

Clear Dumping Height	—16′ 10″
Dumping Radius	—24′ 2″
Digging Radius	—27′ 11″

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(Continued from page 79)

asphalt was applied to a width of 24 ft., the bituminous material being put down in split applications to prevent the asphalt from running on the sloping subgrade. Sand was spread on the final application of asphalt, and the forms were reset to permit the placing of concrete. When the slab had cured and attained sufficient strength, the distributor was able to travel on the concrete to make the shoulder application. By overlapping this application along the edge of the slab, on top of the previous subgrade membrane, the distributor sealed the form pin holes and other breaks caused by construction operations.

Interspersed among the clay subgrade portions of the job were a number of sections, varying in length from 100 ft. to 3 mi., where no asphalt was required. This fact made it impossible to spot cars of asphalt on the job with accuracy and economy, and the contractor decided to haul all asphalt from the plant in Houston, the one-way haul distance varying from 35 to 90 mi. Tank trucks of 1,000-gal. capacity delivered asphalt to the 1,090-gal. Littleford distributor. The special outrigger for this distributor was made in the shops of the Houston Welding & Machine Works.

Highway Project

Extending from the town of Katy in Harris County, about 30 mi. west of Houston, to a point near Columbus in Colorado County, the 42-mi. project completes the main highway between Houston and San Antonio and saves about 25 mi. over the old route. The project was constructed by three contractors: the Gulf Bitulithic Co.; Cage Bros. & H. E. Williams; and the Briggs-Killian Co.

★ ★ ★

INDIANA
Salvages Old Slab

(Continued from page 58)

achieve a uniform surface appearance throughout the 11.8 mi. of new construction, the gaps between salvaged sections of old slab were likewise paved with concrete base covered by bituminous material on the two inner lanes.

Accompanying cross-sections indicate the design of pavement and of separating curb under two conditions, with and without incorporation of the old slab. With reference to the curbs, shown separately in an accompanying sketch, Type A is the center separating barrier placed on salvaged base. The curb has a core of ordinary gray portland cement concrete covered by a ¾-in. thickness of white portland cement concrete. To increase light reflection at night, recesses (called grooves in the drawing) ¾-in. deep and 6-in. wide are set into the edges of the curb at 10-ft. intervals. The curb was not anchored to the old slab, and curb concrete was placed on subgrade paper laid on the existing pavement. Type A has a cross section of about 1.85 sq.ft. and weighs roughly 275 lb. per linear foot. The two other types of white concrete center curb were constructed in the gaps where old slab had been displaced, Rieth-Riley building type B (1) and O'Connor type B (2).

As will be noted from the pavement cross-section, old slab, when preserved, was widened the required distance of about 4 ft. at each edge by the addition of a 7-in. plain concrete filler strip between the salvaged base and the new reinforced-concrete outer lane. On the widened base was placed a leveling course and a 1½-in. binder course of hot-mixed hot-laid bituminous concrete, followed by a ¾-in. wearing course of rock asphalt. In the gaps where no old pavement remained in place, a 6-in. base of plain concrete was constructed for the asphaltic surface of each inner lane.

Curb Construction

To build the center curb, it was necessary to have side forms which could be held to line and grade, but it was equally important that the form supports should not interfere with the screeding and finishing of the concrete in the curb. The Rieth-Riley contract had been awarded months in advance of others on the project, and this firm accordingly was the first to undertake curb construction. For the curb forms the contractor worked out a successful solution in the shape of steel frames made up of welded angles and channels, with cross-ties between the two sides connected to posts at a sufficient distance above the curb to permit the operation of a strike-off and finishing tools below the cross members. Accompanying photographs show the construction of the forms.

Gray portland cement concrete for the core of the curb was struck off by a three-bladed screed, or mule, riding on the form rails. The strike-off was pulled forward by a cable running to a winch. Gray concrete was delivered by truck mixers from a commercial plant in Michigan City, and white concrete for the ¾-in. top was mixed in two-bag batches on the job and was placed by shoveling from wheelbarrows. Wood blocks were set on the gray concrete core to form the recesses in the white concrete edges of the curb, and the white concrete was struck off and finished with hand tools, including a brass trowel shaped to the contours of the curb, as illustrated by a photograph.

Forms were removed within a few hours after concrete had been placed, and the curb then was covered with two-ply waterproof reinforced paper cemented to the vertical sides of the curb with a sealing compound. To build 17,500 lin.ft. of curb, Reith-Riley used 500 lin. ft. of forms made up in 15-ft. units, with cross-braces spaced 5 ft. apart. With this equipment the contractor completed curb at rates up to and exceeding 1,200 lin. ft. of curb per 8-hr. day.

Forms of similar construction were employed on the O'Connor paving work, which involved almost 37,000 lin. ft. of center curb. Gray concrete in this case was

(Continued on page 82)

Appreciative of the continued good will of our friends everywhere, we extend to them our heartiest best wishes, and a sincere hope that the year 1941 will be a highly successful and thoroughly prosperous one.
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AMES BALDWIN WYOMING CO.
PARKERSBURG, W. VA. NORTH EASTON, MASS.

(Continued from page 80)

mixed by an old 27E paver, and both the gray concrete core and the white concrete top were stuck off by steel mules drawn forward by a line attached to a winch. This outfit built as much as 1,600 lin. ft. in 8 hr.

Grading Equipment

Average grading quantities for the entire 16½-mi. improvement, including Bontrager's 4.6 mi. on S. R. 2, amounted to about 50,000 cu.yd. per mile. On two contract sections graded and paved by J. C. O'Connor & Sons, Inc., the volume of excavation was 370,000 cu.yd., including 85,000 cu.yd. of borrow, in a distance of 7.8 mi. The maximum cut was 48 ft. deep and the greatest fill was 45 ft. high.

Materials excavated included sand, clay and silt. The contractor operated one excavator, a Lorain 2-yd. diesel shovel, loading three Euclid 12-yd. gasoline-powered pneumatic-tired tractor-wagon units. On average hauls of 1,800 ft., this outfit moved 2,500 cu.yd. of pay dirt in two 8-hr. shifts. For the same contractor, a scraper fleet composed of four LeTourneau 12-yd. scoops drawn by Caterpillar 96-hp. diesel tractors and one Heil 8-yd. unit drawn by an Allis-Chalmers 80-hp. diesel-fuel tractor worked on average one-way haul distances of 750 ft. and moved 4,000 to 5,500 cu.yd. in 16 hr.

To move the bulk of 300,000 cu.yd. of excavation, including 24,000 cu.yd. of borrow, on the Bontrager section, the contractor operates three power excavators and a fleet of three LeTourneau 14-yd. scrapers drawn by Caterpillar 96-hp. diesel tractors. On one-way hauls of 300 to 350 ft., the scraper fleet has moved 5,000 cu. yd. in 16 hr. Smaller volumes are handled on longer hauls up to 1,000 ft. The three excavators are Northwest gasoline units: a 2-yd. dragline with a 70-ft. boom, a 1¼-yd. dragline and a 1¼-yd. shovel.

All the contractors, including the Rieth-Riley Construction Co., excavated peat deposits to sound bottom and backfilled with selected material containing not more than 10 per cent silt or clay. Estimated contract quantities for the entire project called for the removal of almost 65,000 cu.yd. of peat.

Fills on all sections were built up in 6- to 9-in. layers with close control of moisture and compaction to meet the specified requirement of 95 per cent maximum compaction, tested by the Proctor method. Disk harrows, sheepsfoot tampers and flat steel rollers were used on the fill layers, in conjunction with sprinkler trucks where needed.

Paving Operations

For concrete pavement construction, the O'Connor organization operated a particularly interesting plant comprising two Koehring 27E pavers, two of the new Blaw-Knox transverse blading concrete spreaders and two finishing machines. When building 11-ft. outer lanes of 9-7-9-in. reinforced concrete, all the units worked as a team. The first paver placed concrete for the lower course, which was struck off 2 in. below final grade by the first spreader to receive reinforcing mesh.

(Continued on page 84)

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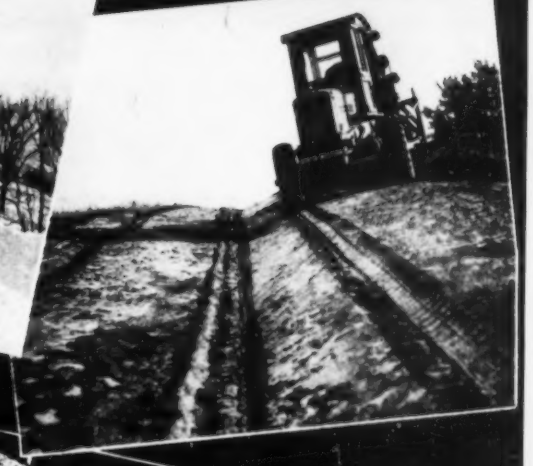

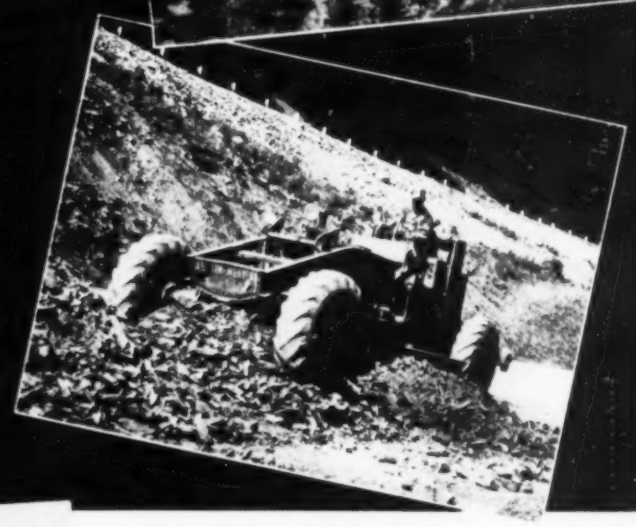

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THE Modern TRUCK MIXER and AGITATOR

(Continued from page 82)

Behind these two units, a second pair of machines placed and spread the 2-in. upper course of concrete. When the second paver caught up with the first, as usually occurred in a distance of 150 to 200 ft., the forward mixer pulled ahead 30 to 50 ft., leaving a gap in the lower course to be filled in by the second paver. The two finishers followed the second mixer and spreader on the top course.

With all units working in this way on 11-ft. lane of 9-7-9-in. cross-section, the paving outfit placed and finished 2,900 to 3,000 ft. in an 8-hr. day, handling up to 725 batches. The combination was broken up into smaller outfits to place plain concrete base for the asphaltic surfacing. When building 6-in. base 11 ft. wide, one paver and one finishing machine completed up to 1,900 lin. ft. in 8-hr., mixing 400 batches; no concrete spreading machine was used on this work. For 7-in. plain concrete filler strip 4 ft. wide, between salvaged slab and new outer lane, one paver was able to place up to 3,000 lin. ft. in 8 hr. This concrete was struck off with a hand screed.

Asphaltic Surface

A Lang asphalt plant leased first by Rieth-Riley and later by O'Connor from the Mid-America Engineering Corp., Chicago, produced asphaltic concrete for the leveling and binder courses on the two inner lanes. The plant was set up on a railroad siding near the center of the 11.8 mi. to be surfaced with the asphalt material. Total requirements for the leveling and binder courses amounted to 12,000 tons.

An Adnun black top paver spread the asphaltic concrete in the binder course and the rock asphalt in the ¾-in. wearing course. In all, about 4,250 tons of Kentucky natural rock asphalt was placed in the top course. A 10-ton tandem roller and two 10-ton three-wheel rollers compacted the leveling,. binding and wearing courses.

Contract Dates

Rieth-Riley's contract for grading and paving 4.034 mi. was awarded Aug. 21, 1939, on a bid price of nearly $368,000. Completion was specified by Oct. 1, 1940. O'Connor's grading and paving work included two adjoining contracts. The first, valued at $418,000, for 4.374 mi., was awarded April 8, 1940, and the second, bid in at a little more than $277,000 for 3.404 mi., was awarded June 3. Both contracts called for completion by the same date, Dec. 1, 1940.

Bontrager's contract for the 4.597-mi. eastward extension, valued at almost $360,000, was not awarded until Aug. 5. The specified completion date is Oct. 1, 1941.

Grade Separations

Two railroad grade separation bridges are involved in the present improvement. The Jutton-Kelly Co., Detroit, Mich., received a $40,000 contract March 8 for a plate girder structure of 67-ft. 10-in. span carrying a Pere Marquette single track

(Continued on page 86)

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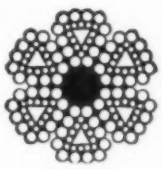

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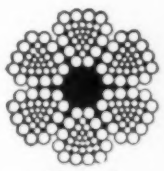

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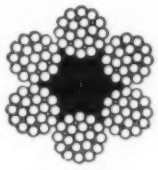

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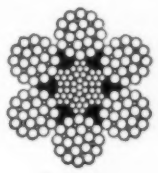
Filler Wire



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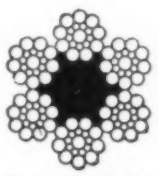
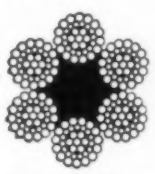
Wire Rope Center



6 x 19 Seale



6 x 37 Type

Round Strand

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There Is *Extra Profit* In Its Plus Value

Use "HERCULES" (Red-Strand) the next time you re-rope. You will soon discover the definite advantages of the Leschen manufacturing policies and methods, which leave nothing to chance. From the initial selection and tests of its materials, to the final inspection of the finished rope, each manufacturing detail is rigidly checked to assure long operating life.

Measure the extra value of "HERCULES" (Red-Strand) Wire Rope by the yardstick of performance. It will bring you extra profit, as well as help speed up your work. With wire rope, it pays to use the best.

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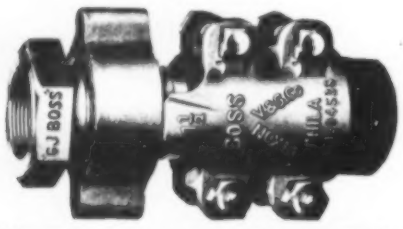


"GJ-BOSS"

GROUND JOINT

FEMALE HOSE COUPLING

STYLE X-34

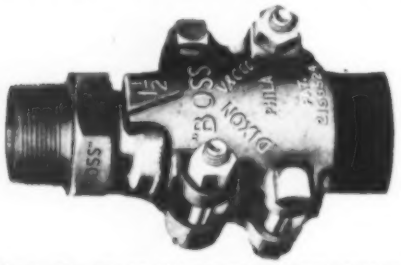
A washerless, leakproof coupling that's guaranteed to provide important savings in service and maintenance costs. Copper insert in spud fits rounded head of stem, forming soft-to-hard metal seal that *will not leak*, regardless of wear or the presence of abrasive particles. No service interruptions to replace washers, and no possibility of blow-offs. Sizes ½" to 4" inclusive, with 4-bolt "BOSS" Interlocking Offset Clamp on 1" and larger; 2-bolt clamp on ⅞" and smaller.

"BOSS" WASHER TYPE FEMALE HOSE COUPLING

STYLE W-16

Same as above, except that head of stem and coupling end of spud are *flat*, to accommodate Washer. Sizes ¼" to 4", inclusive. Cadmium plated—rustproof. All "BOSS" and "GJ-BOSS" Couplings are designed to actually protect the ends of the hose upon which they are used, permitting the hose to be kept in service *longer* without cutting back to reset couplings.

NEW "COR-O-ZIG" STEMS: This patented design affords a *tighter grip* of hose on coupling under clamp pressure. Regular corrugations for half the length of the stem; zig-zag corrugations for the other half. Now furnished in malleable iron on "GJ-BOSS", and "BOSS" Couplings (male and female) in sizes 1¼" and larger. (Corrugated *steel* stems furnished in sizes 1" and smaller).



"BOSS" MALE COUPLING

STYLE MX-16

The companion coupling for the "GJ-BOSS" and "BOSS" couplings described above. Much more practical and economical than standard iron pipe nipple, as it eliminates the need of oversize hose. Cadmium plated—rustproof. Sizes ¼" to 4" inclusive, with same clamps as "GJ-BOSS" and "BOSS" Female Couplings.

NEW CORRUGATED STEEL STEMS: To further increase their strength and durability, "BOSS" Male Couplings, sizes ½", ¾" and 1", now have stems of *corrugated steel*, in place of the malleable iron stems formerly furnished. (Sizes 1¼" and over have Malleable Iron "COR-O-ZIG" Stems, described above.)

Carried in Stock by Leading Rubber Manufacturers and Jobbers.

DIXON

VALVE & COUPLING CO.

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(Continued from page 84)

line over the new highway, and construction was pushed to meet a Nov. 1 completion date. A three-span continuous steel beam bridge to pass relocated U. S. 20 over the New York Central main line tracks is being built by J. C. O'Connor & Sons, Inc., successful bidder at a figure just under $138,000. The latter contract was awarded Aug. 9 and is to be completed by Aug. 1, 1941.

Personnel

T. A. Dicus is chairman of the State Highway Commission of Indiana, and M. R. Keefe was chief engineer until December, when he resigned and was succeeded by Earl B. Lockridge, formerly assistant chief engineer and engineer of construction. Engineering and construction on the U. S. 20 improvement are under the direction of F. E. Bernoske, district engineer, La Porte, Ind.; R. F. Berns is assistant district engineer of construction. On the highway contracts, the project engineers in charge are V. W. Terhune, H. Bowen, L. T. Whetzell and W. M. Sprankle. For the contractors, the following superintendents direct the work: A. O. Krogh, Rieth-Riley Construction Co., Goshen, Ind.; A. D. Blackburn, J. C. O'Connor & Sons, Inc., Fort Wayne, Ind.; C. E. Moore, Bontrager Construction Co., Elkhart, Ind.

* * *

KENTUCKY PROJECT TESTS *Cements and Surface Coloring*

(Continued from page 72)

route to strike into the hills, the lengths of the various sections and the cements used in them (with red surface color noted where applied) are as follows:

(1) 3,700 ft. Standard portland cement plus natural cement, mixed 5:1 by weight on the job. (No grinding aid in the natural cement.)

(2) 3,700 ft. Portland cement plus 0.034 per cent vinsol resin ground in at the cement mill, mixed 5:1 by weight with natural cement on the job. (No grinding aid in the natural cement.)

(3) 3,300 ft. Standard portland cement. Red surface color added to slab.

(4) 3,300 ft. Portland plus 0.034 per cent vinsol resin ground in at the cement mill. Red surface color on slab.

(5) 3,300 ft. Standard portland mixed 5:1 on the job with natural containing a grinding aid ground in at the mill. Red color on slab.

(6) About 1 mi. Portland plus 0.034 per cent vinsol resin ground in at the mill.

(7) About 1 mi. Standard portland cement mixed 5:1 by weight on the job with natural containing a grinding aid ground in at the mill.

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X-200 NATIONAL CARBIDE V. G. LIGHT

Now, more than ever **NATIONAL CARBIDE LIGHTS** are proving their outstanding superiority and value by providing Powerful "Portable Daylight" in all emergencies.

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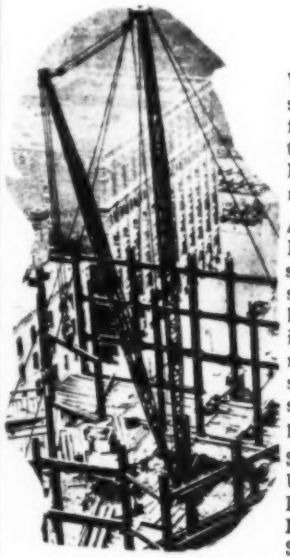
TRADE MARK DOBBIE ESTABLISHED 1867

All Steel DERRICKS



Steel Erectors Guy Derrick, with Ball Bearing Footblock.

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And DOBBIE All-Steel Derricks have been designed for safety and consequent economy. They have a safe load capacity of almost twice their rating. You need this assurance of dependable safety and continuous performance.

SAVE POWER BY USING BALL OR ROLLER BEARING FOOTBLOCKS AND SHEAVES. Built in both Guy and Stiff-leg types. Write for information and prices.

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Just watch one work and you'll see why.

Industrial Brownhoist Clamshells are built in Rope Reeve, Power Wheel, Lever Arm and Link Types. Capacities range from ½ to 15 yards. Booklet 353, containing complete facts, is yours for the asking.

INDUSTRIAL BROWNHOIST

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began field service tests of concrete pavement made with blended portland and natural cements, the use of special cements to increase concrete durability and prevent surface scaling has received ever-widening study by various state highway departments, the Public Roads Administration, the Portland Cement Association, cement companies and engineering organizations. The prevention of scale is particularly important in states where pavement is subject to alternate freezing and thawing, coupled with the use of ice removal salts. Kentucky has little occasion to use ice removal salts, but winters in the state are far from mild, and pavement failures have resulted from freezing and thawing action, together with wetting and drying. As a consequence, the highway department is keenly interested in improving concrete durability and in determining if increased fatigue resistance can be obtained along with reduced volume change. The present tests will provide a factual basis for writing future specifications.

Soon after New York State began its experiments with blended portland and natural cements, investigations of the natural cements giving best results disclosed that these cements contained a small proportion of fat or grease, which had been added as a grinding aid at the mill. The less successful natural cements were practically free from any fat or grease. It was reasonable to suspect that the added fat or grease was the factor that contributed scale-resistance to concrete. Tests of slabs made with portland cement to which fat or grease had been added tended to confirm this assumption.

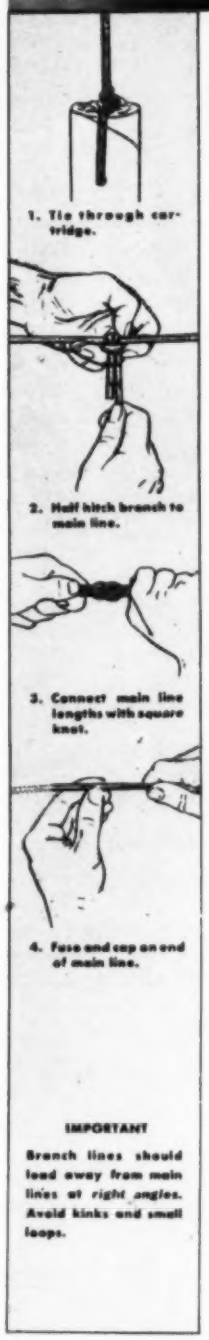
In connection with the tests, it was noted that the slabs displaying the greatest resistance to scale contained more air than other slabs, leading to the plausible assumption that the entrained air had something to do with prevention of scaling. As a substitute for fats or greases previously used in the experiments, a search was made for other substances which would entrain air, and vinsol resin, a wood resin product of uniform quality, was selected as the best all-around material. Depending somewhat upon the cement with which it is mixed, the addition of a minute quantity of vinsol resin (from 0.03 to 0.05 per cent) ordinarily produces the greatest resistance to scaling.

Relative value of vinsol resin ground portland cement as compared with blends of standard portland and natural (with or without the inclusion of fat or grease) in preventing pavement scaling has not been completely established. Kentucky has built its experimental sections to assist in a final determination of the problem and to obtain factual data for its own future use.

Kentucky Specifications

Vinsol resin and materials of a similar nature reduce the weight of concrete by introducing air, uniformly distributed throughout the mass in microscopic globules. The tiny globules increase workability and prevent segregation of the ingredients, but they also reduce the strength, as well as the weight, of the concrete. When

(Continued on page 88)


1. Tie through cartridge.
2. Half hitch branch to main line.
3. Connect main line lengths with square knot.
4. Fuse and cap on end of main line.
IMPORTANT
Branch lines should lead away from main lines at right angles. Avoid kinks and small loops.

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Primacord acts as the detonating agent for each cartridge in a hole. It is also employed to connect holes in firing order planned for proper relief of burden.

It consists of a core of PETN, a powerful detonating agent which produces an explosive wave of nearly four miles per second. Due to the special textile covering, Primacord-Bickford Detonating Fuse has great flexibility, is light in weight, and has adequate strength and waterproof qualities. Send for the Primacord Book—it's free.

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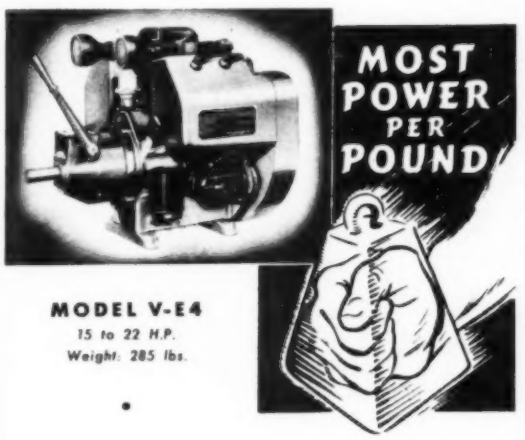

MODEL V-E4

15 to 22 H.P.

Weight: 285 lbs.

THE new V-type, 4 cylinder Wisconsin heavy-duty air-cooled engine packs a terrific power wallop per pound of engine weight . . . more so than any other *heavy duty* engine of comparable weight or cubic cylinder capacity.

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MOST POWER PER POUND HEAVY-DUTY AIR-COOLED ENGINES

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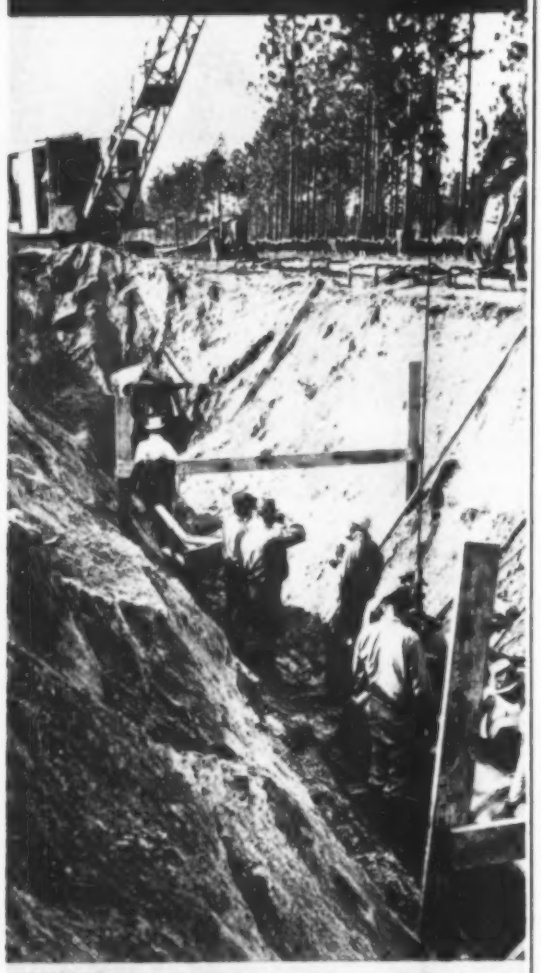
"Job is Powderhouse Dry. Everybody well pleased."



So wires our representative on the Camp Blanding, Florida Defense Project where *progress jumped to approximately 300' per crew per day when Moretrench Wellpoint Systems were installed.* There are no two ways about it. A Moretrench Wellpoint System on any wet job saves the contractor time and money. Thousands of installations prove this fact. Why not take advantage of it?

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Plant: Rockaway, New Jersey
Branch Warehouses:
Joliet, Illinois and New Orleans, Louisiana

(Continued from page 87)

vinsol resin or other substances are added in proper quantity, the loss in weight and strength of concrete pavement is not serious.

Based on New York State test results for vinsol resin ground portland cements indicating that the optimum condition (maximum increase in durability with minimum loss of weight) was obtained when the weight loss was about 5 lb. per cubic foot, Kentucky specifications called for the addition of vinsol resin in sufficient quantity to cause a weight loss of not less than 4 lb. nor more than 8 lb. per cubic foot of concrete. The weight loss was to be determined by comparison with normal portland cement in standard Kentucky pavement mixtures containing six bags of cement per cubic yard, using aggregates supplied to the paving job and a uniform workability or slump for the mixtures to be compared. This method of specifying the amount of vinsol resin to be added represented a departure from the generally accepted practice of other states, which ordinarily name a predetermined quantity of admixture to be ground with the cement. The Louisville Cement Co., which produced all the cements for the job at its Speed, Ind., plant, met the weight loss requirement by grinding in 0.034 per cent vinsol resin with the portland cement.

As an admixture with natural cement, the specifications permitted the use of either (1) not less than 0.2 per cent of prime beef tallow, or (2) not less than 1 per cent petroleum distillate containing approximately 25 per cent wax. The cement producer elected to use 1 per cent of petroleum distillate.

Handling Cements

Portland cements, both standard and vinsol resin ground, were shipped in bulk in hopper-bottom railroad cars which were unloaded at the job by an under-track screw and an elevator into the overhead bin of a Blaw-Knox plant. A weighing hopper under the bin measured the cement for each batch and discharged it through a canvas spout into the proper compartment of a truck spotted on the driveway underneath.

Natural cement, both with and without petroleum distillate, was packed in 63-lb. bags which were shipped in box cars. For the 34E dual-drum paver on this job, the batch size was set at 36 cu.ft., which under ordinary mixing conditions required eight sacks of standard portland cement. When natural cement was being mixed with the portland in 1:5 proportions by weight, the batch trucks stopped at the box car on their way through the cement loading plant, and workmen in the car dumped two sacks (126 lb.) of natural cement into each batch. Portland cement weighed in the hopper of the bulk plant made up the remainder of the 752 lb. of cement required.

When using vinsol resin ground portland, it was necessary, because of the decreased density of the concrete, to do some adjusting of the aggregate weights in order to hold the cement factor at 1.5 bbl. per cubic yard. By maintaining the cement factor constant for a concrete of lighter weight, the mixture was theoretically made richer. In addition, the plasticizing effect of the vinsol resin permitted a reduction in the water-cement ratio. These two factors combined to hold the strength loss to an average of about 20 per cent for the pavement made with vinsol resin ground portland.

Coloring Concrete Slab

On three 3,300-ft. sections, as noted in the list previously given, red color was imparted to the surface of the slab by floating into the fresh concrete a thin topping of Master Builders Co. red highway iron and portland cement. The red highway iron came in 100-lb. bags containing a mixture of 92 lb. of iron filings, graded to specification, and 8 lb. of Spanish iron oxide, plus a plasticizer to increase the workability of the finish mortar.

On the job, 50 lb. of portland cement was mixed with 100 lb. of the red highway iron, and the resulting dry mixture was scattered on freshly finished concrete at the rate of 45 lb. per 100' sq.ft. Two long-handled flat floats were used to work the material into the slab surface to a depth of about 1/16 to 3/32 in. Floating proved somewhat more difficult on concrete containing vinsol resin ground portland cement than on other concretes, but in all cases the thin topping produced a rich red surface color.

When applying color, the contractor increased the size of the paving crew by about four men, one to mix the red highway iron and portland cement, two to scatter the dry mixture on the slab, and one additional man to assist in the floating operation.

Aggregates

Ohio River sand and two sizes of hard limestone were used in the concrete mixture. The limestone was taken out of a quarry alongside old route 31W and was crushed to size (large stone up to 2½-in. maximum and medium up to 1-in. maximum) by Nally & Mudd, subcontractors, Springfield, Ky. At the aggregate batching plant, a 1½-yd. crane charged two 52-ton overhead bins equipped with weight batchers. One bin was fitted with two compartments and two batchers to handle sand and large stone.

Paving Plant — Accompanying photographs show paving operations on the experimental third lane. The same equipment previously had served in placing 22-ft. slab. A Koehring 34E twin-batch paver was followed by a Blaw-Knox gas-electric finishing machine and a Koehring mechanical longitudinal float. The paver operated a strike-off which leveled the first course of concrete to receive reinforcing mesh 2 in. below the surface of the slab.

Progress—Specifications required each batch to be mixed 60 sec., and the time control mechanism on the paver was set for this period. Ordinarily each batch remained in the twin-compartment drum for a total of about 75 sec., and the interval between successive batches dumped between the forms was about 50 sec.

In building 22-ft. pavement, the con-

(Continued on page 90)

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ON CLOSE-MARGIN JOBS

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When the going's tough — and operating schedules must be met — that's the time when contractors who are using dependable Heil dirt-moving units appreciate the features of Heil design and construction that insure profitable operation even under the toughest working conditions . . . Fast operating — fool-proof — efficient — and dependable — Heil Road Machinery is designed and built to see the tough jobs through on time with a minimum of service and maintenance expense . . . Send today for free catalog covering Heil Cable Scoops, Heil Hydraulic Scoops, Heil Trailbuilders and Bulldozers, Heil Tamping Rollers and Heil Hydraulic Dump Units.

THE HEIL CO.

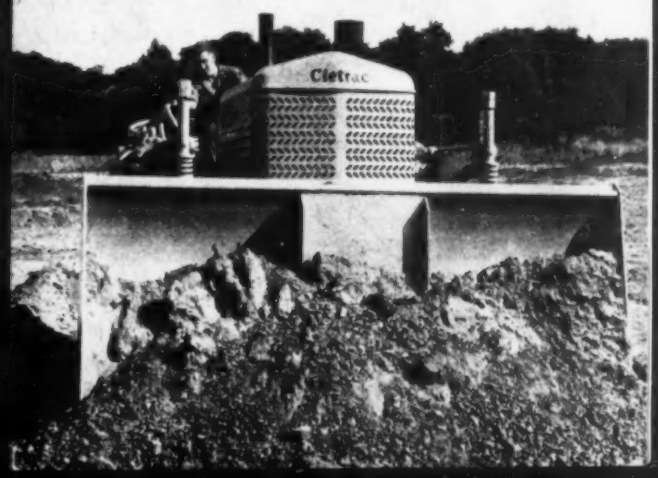
MILWAUKEE, WISCONSIN • HILLSIDE, NEW JERSEY

Left: One of a fleet of 12-yard Heil Rock Bodies at the TVA Cherokee Dam.

Above: Heil Dig-N-Carry Cable Scoops haul more yards per day and insure profitable operation on the "tough" jobs.

Heil Hydraulic Dig-N-Carry Scoops load fast and dump fast in any type of soil.

Heil Hydraulic Bulldozer mounted on Model F Cletrac. Plate at center of blade is for Push-loading.



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(Continued from page 88)

tractor averaged close to 600 batches per day of two 6-hr. shifts. On some days the two crews placed 650 to 668 batches. When working on experimental sections in the third lane, progress was somewhat slower.

Finishing and Curing

Behind the mechanical longitudinal float, the concrete was floated with two long-handled floats and was straight-edged with a 10-ft. aluminum straight-edge before being broomed. Some variation was experienced in ease of finishing concrete made with the different cements.

Of the various cements used, the finishers found concrete containing normal portland to be the easiest to finish because the concrete bled and fines came to the surface. Next, from the standpoint of ease of finishing, was the portland cement blended with natural containing no grinding aid; with this combination there was no bleeding nor excessive stickiness. When standard portland was blended with natural containing petroleum distillate as an admixture, the resulting concrete was slightly more difficult to finish.

Vinsol resin ground portland cement, as expected, produced a concrete of a sticky consistency almost jelly-like in quality. Although the concrete possessed excellent workability, its stickiness at first caused some difficulty in finishing. To aid in the finishing, a slump of 2½ in. was desired. On steep grades, however, the slump had to be reduced to 1½ to 2 in., and this concrete had a tendency to tear under the straight-edge. After a change had been made to steel-shod floats, any tendency to tear during floating was practically eliminated. Because of the lack of bleeding on the concrete, the finishers were able to follow the mixer closely, reducing the waiting time before final finishing.

All pavement on the job was cured under wet burlap for 24 hr. and under waterproof paper for 48 hr.

Features of Pavement

On grades of 1½ per cent or greater, lip curb 3 in. high was added to the outer edges of the pavement. The entire length of the job (8.58 mi. to be exact) had previously been graded 48 ft. wide for eventual extension of the third lane to the south end of the project; shoulders are 7½ ft. in width. Where the pavement has lip curb, the shoulders are built on a slope of ½ in. per foot, draining toward the pavement. From the pavement, the water is carried off by concrete flumes or box inlets.

Pavement cross-sections for both the 22-ft. and the 33-ft. widths is 9-7-9 in., with the 7-in. thickness increased to 9 in. only at the outer edges. Doweled 1-in. expansion joints were installed at 120-ft. intervals, with doweled transverse contraction joints at 60-ft. spacing between them. Longitudinal joints between 11-ft. lanes were formed with crimped steel plates, and adjacent slabs were tied across the joints with steel bars. Subgrade paper was required under the slab to prevent

(Continued on page 92)

A Five Star Final on PIPE ECONOMY

Here's good news on drainage and sewerage jobs. You can stay ahead of schedule and under the estimate by using ARMCO Corrugated Paved Invert Pipe. Check these five profitable advantages:

1

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Unskilled men can install ARMCO Pipe in short order. Long lengths (20 to 30 feet) are handled safely with ropes and plank skids. Band couplers make strong, tight joints. And there's little danger of damaging ARMCO Pipe. Cracked sections can't delay the job.

2

HOLDS GRADE AND ALIGNMENT

Shifting soils and unstable foundations are no problem when you use ARMCO Paved Invert Pipe. Band couplers and flexible corrugated metal design see to that. Just ordinary care in preparing the trench assures proper grade and alignment. Cradling is seldom needed.

3

4

LAUGHS AT BAD WEATHER

Ice and frost or other bad weather holds no terror for ARMCO Paved Invert Pipe. You can install it in any season without special protection or troublesome curing.

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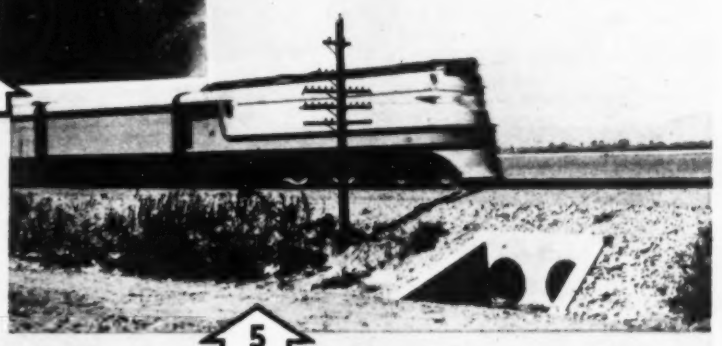
ARMCO tailor-made fittings go in slick-as-a-whistle. You're bound to save time and money with standard tees, wyes, elbows, or other "specials" custom-built to fit the job.



5

STRENGTH TO SPARE

ARMCO Pipe takes the weight of high fills and traffic impact in stride. The flexible design provides strength to meet loading specifications with a wide margin of safety.

ENGINEERS SAY OKEH: ARMCO Paved Invert Pipe also brings this double assurance of low-cost, trouble-free service: (1) A base metal of galvanized ARMCO Ingot Iron — proved in 35 years of service; (2) The added protection of a thick, bituminous pavement in the bottom to guard against corrosion and erosion where the wear is hardest. Engineers appreciate this extra durability and accept ARMCO Pipe without question. Write us today for prices. ARMCO DRAINAGE PRODUCTS ASSN., 502 Curtis St., Middletown, O.

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CHANNEL STEEL LEGS WITH SHOES

Where tray sheets lap, both sheets are folded around the butt-welded rod in top edge, forming double reinforcements, as shown by the cross-section at the left. This is an extra Sterling value.

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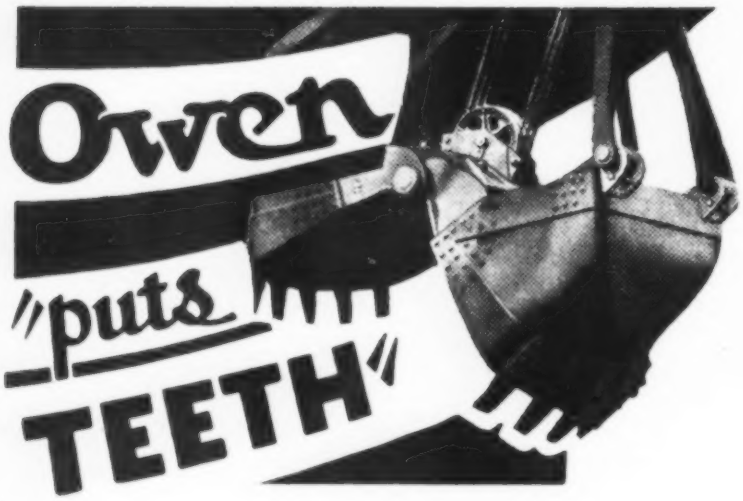

Owen "puts teeth into your digging" with unusual results by equipping an extra efficient bucket with teeth particularly adapted for the work at hand.

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The OWEN BUCKET Co.
6020 Breakwater Ave., Cleveland, Ohio
Branches: New York Philadelphia Chicago Berkeley, Cal.

-in Your Digging

(Continued from page 90)

moisture loss from the concrete, and the pavement was reinforced with 60-lb. mesh installed 2-in. below the surface.

Administration—Experimental features of the project were set up and supervised by F. Paul Anderson, II, research engineer for the Kentucky Department of Highways. T. H. Cutler is state highway engineer. Construction was under the direction of G. L. Logan, construction engineer, Dewey Sparks, resident engineer, and F. L. Anthony, assistant resident engineer. For F. C. Gorrell & Son, contractors, Russellville, Ky., Browning Gorrell, a member of the firm, was in charge of the job.

* * *

VEHICULAR TUNNEL ROADWAYS PAVED WITH *De-Aired Brick*

(Continued from page 46)

lane markers between them, giving two traffic lanes with roadways approximately 11 ft. 3 in. wide. From the center line the pavement slopes toward each curb at a rate of 1 in. in 10½ ft.

The roadway base is a 15-in. concrete slab carried by 10-in. I-beams spaced on 21-in. centers. In addition to supporting the tunnel roadway, this slab also serves as the roof of the lower ventilating duct for delivering fresh air within the tunnel. The river tunnels, built of cast-iron rings by the shield method, have outside diameters of 31 ft. and are lined with concrete, faced with glazed tile. Vertical clearance for vehicular traffic between roadway surface and ceiling formed by the bottom of the upper ventilating duct is 13½ ft. Steel curbs extend along the sides of the paved roadways.

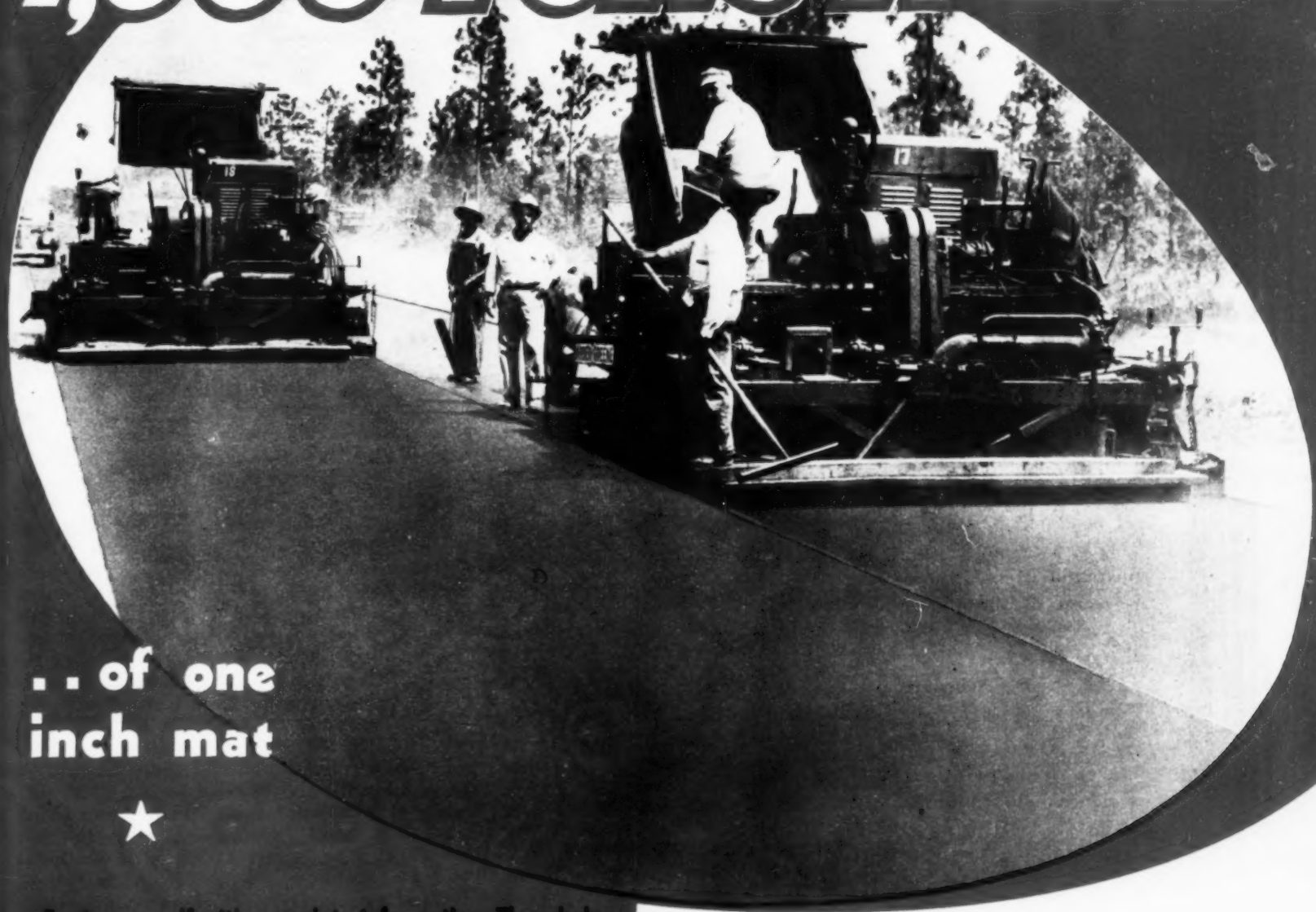
Contract for paving the tunnel roadways and entrance and exit plazas, involving a total of 42,100 sq.yd. was awarded to W. J. Fitzgerald, contractor of New York, at a bid price of $192,319. The Fitzgerald organization is experienced in this type of work, having paved both the Lincoln and the Holland tunnels under the Hudson River between New York and New Jersey. Unit prices for the principal contract items were as follows: Brick pavement (40,800 sq.yd.), $3.84 per sq.yd.; white vitreous brick lane markers (16,600 lin.ft.) $1.10 per lin.ft.; concrete block pavement (720 sq.yd.) $3.65 per sq.yd.; illuminated lane marker units (106), $129 per unit; air measurement cover boxes (110), $6 per unit.

Paving Procedure

Paving procedure involved six main operations: (1) application of a prime coat of cut-back asphalt to the concrete base of the roadway; (2) laying of a sand-mastic cushion course ¾ in. thick; (3)

(Continued on page 94)

AVERAGING 1,000 TONS A DAY



. . of one inch mat

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The State of Georgia is using two of its Barber-Greenes on this two course job from Jesup to Nahunta, not only proving the excellence of Barber-Greene pavement and the economy of B-G operation, but the way in which Barber-Greenes set the pace for the whole project.

40-13

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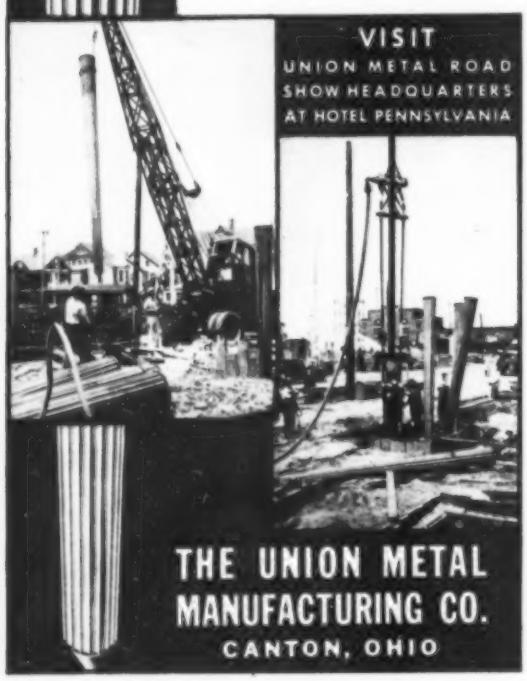
• Construction of a grade separation for the Long Island Railroad in Queens, New York City, involved the installation of 5,700 piles along a 1½ mile length. Monotubes were approved for the job after tests proved their ability to carry the specified 40-ton working load safely.

The 18′ 8″ tapered steel casings were installed by Tully & Di Napoli, Long Island City, N. Y., who jetted the Monotubes to near final position, then drove the following day to final penetration. Figures show an average of one Monotube was installed every 3 minutes. As a result, the original driving schedule of 4 months was cut in half.

Speed, savings, safety . . . Monotubes bring all three to foundation work, and there's a gauge, taper and length to meet every soil condition. Write today for copy of Catalog No. 68A.



(Continued from page 92)

paving with de-aired brick; (4) spraying of paved brick surface with separating agent to facilitate removal of excess joint filler; (5) application of hot asphalt joint filler; (6) removal, by scraping, of excess joint filler to produce clean paved surface.

The specifications called for de-aired vertical-fiber lug brick, wire-cut on top and bottom. The bricks, supplied by the Metropolitan Paving Brick Co., are 3½ in. deep, 4 in. wide and 8 in. long and have square edges. Each brick carries on one side a pair of ⅛ to ¼-in. lugs to insure uniform joint width when laid. In addition each brick carries on one side two vertical grooves to facilitate the flow of the asphalt filler into the joint. The white vitreous brick used for marking the center line between traffic lanes has edges rounded to a ⅛-in. radius. At about 50-ft. intervals along the roadways of the entrance and exit plazas are installed transverse expansion joints of premolded cork, a Johns-Manville product, ¼ in. thick and 3 in. deep, so that the top of the cork strip in place is ½ in. below the surface of the brick pavement. These cork expansion joints were placed directly over expansion joints in the concrete base, which were covered with canvas strips 6 in. wide, laid on hot asphalt and covered with cut-back asphalt sprayed on prior to laying the mastic cushion.

To serve as a bond between the mastic cushion course and the concrete base slab of the roadway there is applied to the latter a prime coat of cut-back asphalt, sprayed on by pumping from small portable tanks. The rate of application of this prime coat is 1 gal. for every 12 sq.yd.

The asphalt mastic cushion course, ¾ in. thick, is made up of from 93 to 97 per cent dry sand and from 7 to 3 per cent asphalt, with penetration limits at 77 deg. F. of from 70 to 110. It is struck off to proper depth by a template riding on a carriage of the trunnion type with eight disk wheels, as illustrated in one of the photographs, for work in the open; in the tunnel rollers riding on the curb were substituted for the disk wheels. The screed of this strikeoff is a 3x10-in. plank armored on the bottom with a strip of ¼-in. angle iron serving as a cutting edge. It was the practice to keep the laying of the mastic cushion at least 50 ft. ahead of the actual brick laying. For the cushion course a smoothness test was specified calling for no variation of surface greater than 3/16 in. in a 10-ft. length of straight-edge.

Paving brick piled along the roadway curb were delivered by hand to the droppers who bedded them on the mastic cushion in the usual manner, working from the center of the roadway outward to the curbs. A complicating factor in paving operations was the necessity of keeping one traffic lane open for delivery of materials to the other contractors placing the tile lining and other interior finish for the tunnel. Paving therefore was done in 10-ft. lanes, starting with the white brick center line marker and working toward the curb. Rolling was done with a 5-ton Buffalo-Springfield gasoline-powered roller operating on planks 12 ft. long 10 in. wide and 13/16 in. thick, laid with end joints staggered. Rolling on plank equalized load distribution and bedded the brick in the mastic cushion without rocking or crowding the individual bricks.

Joint Filler

Prior to application of asphaltic joint filler, the brick surface is sprayed with a separating agent consisting of a solution of 35 per cent calcium chloride, 1 per cent laundry starch and 64 per cent water. This solution prevents adherence of the excess asphalt joint filler to the surface of the brick and facilitates its removal by hand scrapers.

Joint filler consists of Socony cut-back asphalt to which is added 20 to 30 per cent, by weight, of inert fine material in the form of powdered slate. For the asphalt filler penetration limits were specified as follows: at 32 deg. F., 15; at 77 deg. F., 25-35; at 115 deg. F., 47-65.

The joint filler was heated in batteries of 500-gal. asphalt kettles installed at the Long Island end of the tubes and was delivered to points of use in the tunnel by small three-wheeled Clark rubber-tired truc-tractors hauling two-wheeled Aeroil heating tanks of 300-gal. capacity. Temperature of the filler when applied had to be between 400 and 450 deg. F. Hot filler was flushed by dumping 5-gal. pails by hand on the brick surface, so as to fill the joints completely and leave a surplus of filler of at least ⅛ in. on top of the brick. Specifications prohibited squeegee buggies or wheelbarrows for this operation and also banned the use of squeegees or lutes to manipulate the filler. After the filler had cooled to a leathery consistency the excess on the paved surface was removed in transverse strips (not more than 4 brick wide) by hand scrapers. The excess filler thus reclaimed was reheated and reused, with sufficient new material added to prevent excess foaming.

Paving operations in the Queens-Midtown tunnel were directed by the New York City Tunnel Authority of which Ole Singstad is chief engineer, William McK. Griffin, deputy chief engineer, and Jacob Mechanic, construction engineer. For W. J. Fitzgerald, contractor, J. J. Fitzmaurice was manager and J. A. Williamson, general superintendent.

* * *

Spreader-Roller APPLIES CHIPS TO CANADIAN AIRPORT

(Continued from page 45)

deposited the coarser fragments first and placed the finer chips on top.

As indicated by a time study on the job, the unit moved at an actual spreading speed of 1.08 m.p.h., covering 5,280 sq.yd. of runway in 50 operating minutes with 113,800 lb. of chips, an average of 21½

(Continued on page 96)

Big pay loads X fast cycle
= LOW COST DIRT

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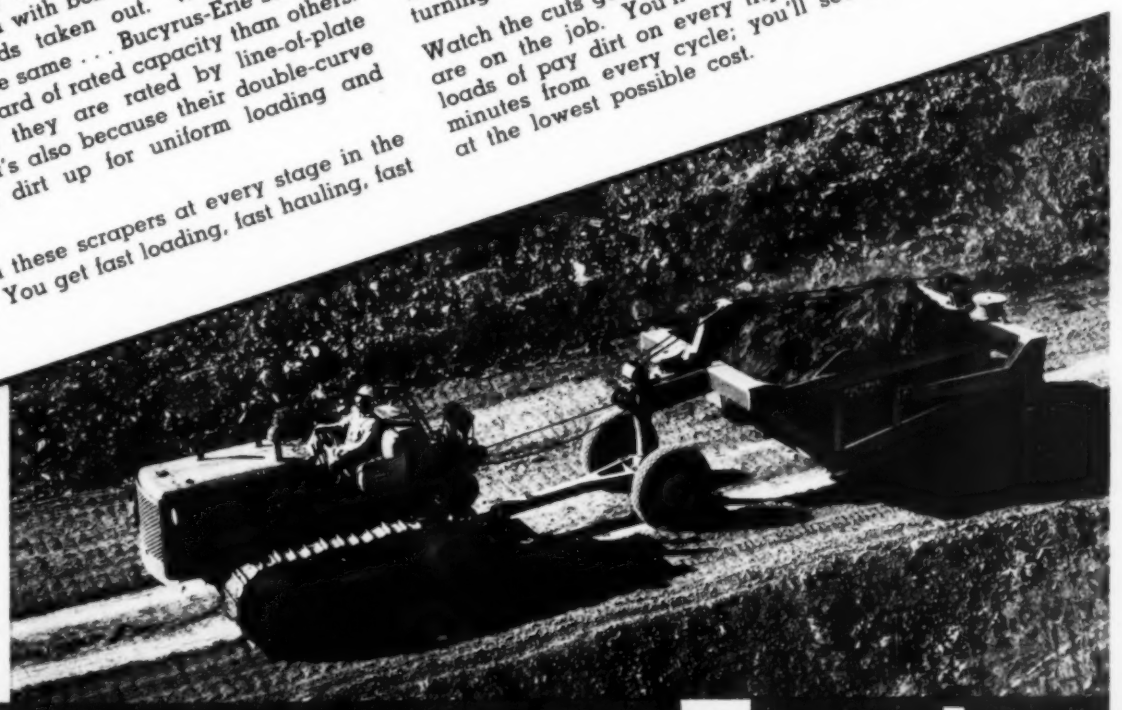
TRACTOR EQUIPMENT

CHECK the big loads of pay dirt you get with Bucyrus-Erie scrapers, in any way you wish. Weigh them with scales; measure them with boxes; divide bank measure by number of loads taken out. Whatever your method, the answer is the same . . . Bucyrus-Erie scrapers get more pay dirt per yard of rated capacity than others. That's partly because they are rated by line-of-plate struck measure. But it's also because their double-curve cutting edges break dirt up for uniform loading and reduce voids.

You get speed with these scrapers at every stage in the dirt-moving cycle. You get fast loading, fast hauling, fast ejection, fast turning. They give you big loads in short distances because the double-curve cutting edge "boils" the dirt up and keeps it on the move for fast easy loading. They haul fast because of their balanced weight, made possible by simplicity in design and construction. They eject fast because they roll the dirt out of the bowl. They turn fast because of their unusual stability and short turning radius.

Watch the cuts go down fast when Bucyrus-Erie scrapers are on the job. You'll see them hauling big yardage loads of pay dirt on every trip; you'll see them cutting minutes from every cycle; you'll see them moving dirt at the lowest possible cost.



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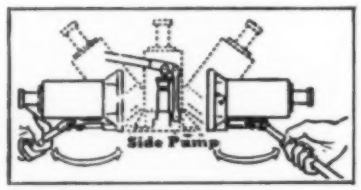

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BLACKHAWK
WORLD'S LARGEST MANUFACTURER OF HYDRAULIC JACKS

(Continued from page 94)

lb. per square yard. Total working time involved in this operation amounted to 120 min., the additional 70 min. being consumed in turning at the ends of the runways and in waiting for material trucks to dump their loads and drive off the ramp.

Runways were built up in two 3-in. courses containing material up to 1-in. size. Each course was sprayed with water and rolled. With the top course, the contractor applied 26 lb. of salt per cubic yard. After the surface of this course had dried, the top was sealed with ¼ imperial gal. per square yard of MC-1 cut-back asphalt. The sealed surfaced was allowed to stand 36 hr. before an application of RC-4 cut-back asphalt was made at the rate of ¼ imperial gal. per square yard, covered by the spreader-roller with 20 lb. per square yard of chips, ½ in. and smaller. For the final surface treatment, the contractor applied 1/5 imperial gal. per square yard of RC-4 and covered the liquid asphaltic material with 20 lb. of ¼-in. and smaller chips.

* * *

MICHIGAN BUILDS *First Military Highway*

(Continued from page 39)

Through the cooperation of the Public Roads Administration and the War Department the Michigan State Higway Department was able to advertise and receive bids on Sept. 25, 1940 for 2.337 mi. of concrete paved highway within the fort area. Five days later Lewis & Frisinger and E. P. Schwaderer, bidding jointly, started construction on this United States military road (US-12A) which, when completed, will consist of four 11-ft. lanes with rolled curb, divided by a 4-ft. bituminous strip. This divided highway cross-section was selected to permit certain army maneuvers that might require the full width of 48 ft. within the fort area. The sandy loam soil permitted the contractor to carry on his grading operations without any delays. After the subgrade was built and properly compacted with a 10-ton roller, the two 22-ft. slabs were laid independently, permitting the use of a finishing machine.

Pavement Specifications

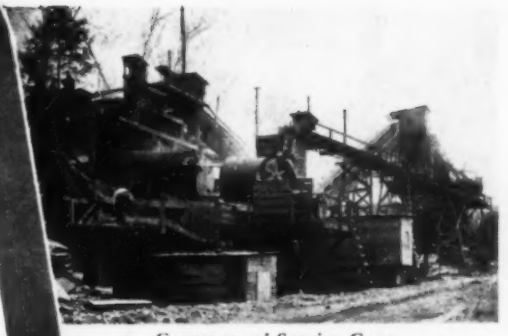
Our regular 8-in. pavement with a thickened edge of 10 in. at each longitudinal joint was used, with steel reinforcement throughout. Dowel bars were used to tie longitudinal and transverse joints together. One-inch transverse expansion joints were laid independently, permitting the ft. and transverse plane-of-weakness joints were placed at 30-ft. intervals between the expansion joints. Load transfer devices were placed at the expansion joints and at the plane-of-weakness joint located

(Continued on page 98)

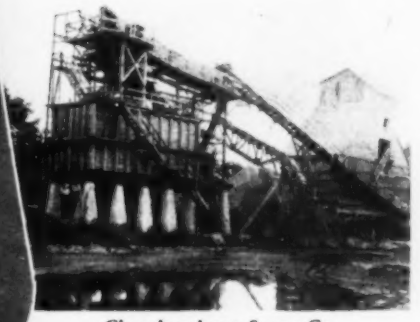
For Pennsylvania's Turnpike

TELSMITH EQUIPMENT

Served in These Twelve Commercial Quarry Plants

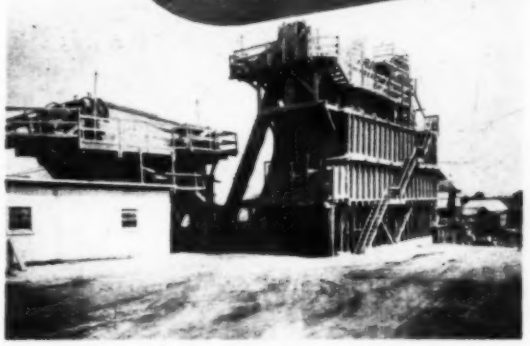


Contractors' Service Corp.
Shade Gap, Pennsylvania

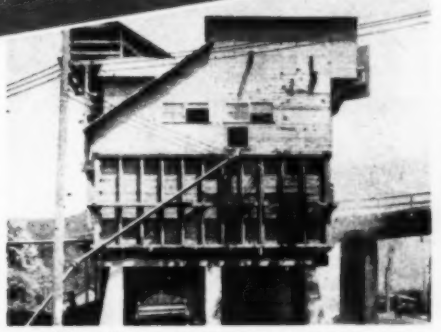


Chambersburg Stone Co.
Chambersburg, Pa.

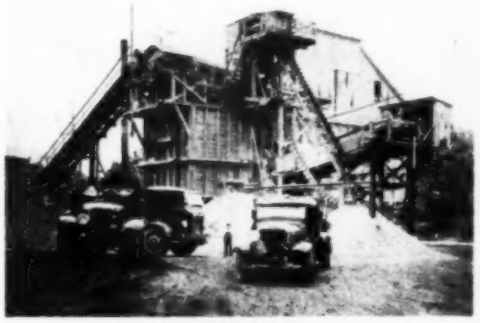
Binkley Bros. & Ober
Dry Run, Pennsylvania



Shippensburg Stone Co.
Shippensburg, Pa.

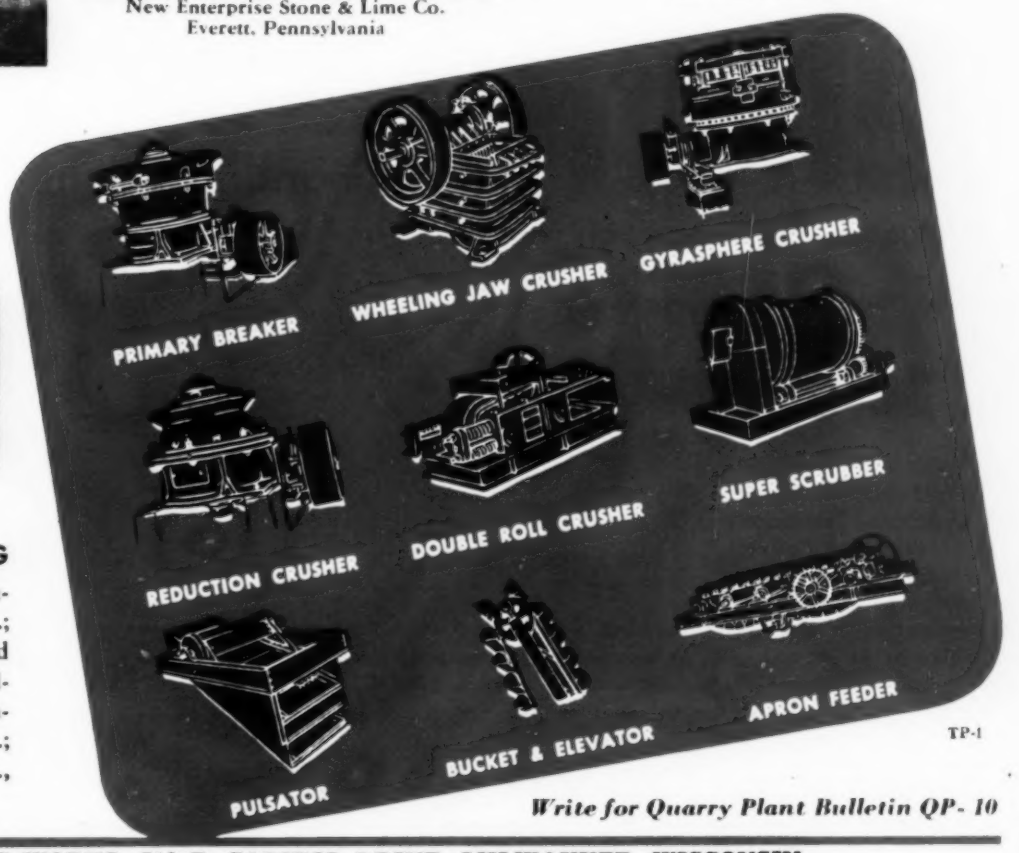


New Enterprise Stone & Lime Co.
Everett, Pennsylvania



H. B. Mellott
McConnellsburg, Pa.

OTHER PLANTS (not shown) USING TELSMITH EQUIPMENT: Hunkin-Conkey Construction Co., Somerset, Pa.; J. F. Sours, Carlisle, Pa.; Vang Crushed Stone Co., Connellsville, Pa.; Pennsylvania Supply Co., Harrisburg, Pa.; Lycoming Silica Sand Co., Montoursville, Pa.; New Enterprise Stone & Lime Co., Roaring Springs, Pa.



TP-1

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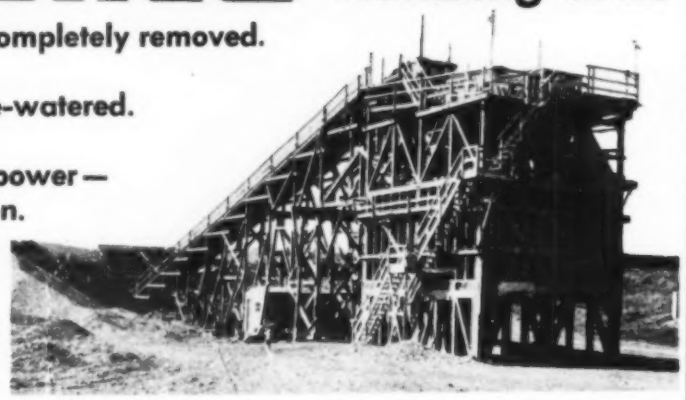

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(Continued from page 96)

midway between expansion joints. The surface of the pavement was straightedged to assure a smooth surface that would not vary more than ⅛ in. in 10 ft.

The pavement was initially cured by the use of a wet burlap. The following day the burlap was removed and straw was used for protection from the possible freezing weather for a period of 7 days. A 30-in. rolled curb on either side of the project was constructed independent of the pavement operation, but was tied into the slab with dowel bars. The concrete base for the division of traffic will be constructed independently of the two slabs but tied into both slabs with dowel bars. A 1½-in.-thick bituminous surface will be placed on this center section.

Concrete used in the construction of this project was designed by the "mortar void" theory for grade A concrete to have a minimum compressive strength of 2,500 lb. per sq. in. and modulus of rupture of 650 lb. per square inch in 28 days.

Additional Improvements Necessary

Alignment has been established for the completion of this military highway between Battle Creek and Kalamazoo. To complete this important military highway it will be necessary to build an additional 11.3 mi. of concrete pavement, three grade separations, and two bridges, estimated to cost $1,900,000.

The Michigan State Highway Department has completed a condition report on the military highway system within the state. The report anticipates the need of that system when brought up to a standard conforming with requirements for military transportation. However, a congressional appropriation will no doubt be necessary before improvement of these military roads can be undertaken on any large scale.

* * *

Dredged Fill CARRIES PARKWAY THROUGH GORGE

(Continued from page 55)

are pumping in sandy material taken in part from the adjoining ship-channel improvement project. Subgrade elevation is some 40 ft. above low water and is at extreme 1894 flood level. In some places the rock toe walls are built out in water depths of 60 ft.

Three contracts have been completed on the toe wall, covering a total distance of 5 mi. Another mile of rock toe will be required in the first 18 mi. of the route. These contracts required the development of four quarries from which the truck haul to the toe wall averaged 1 mi. Two grade separations were constructed under the Union Pacific railroad and one under the

(Continued on page 100)

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For real savings in dollars and manpower a SCHRAMM gives you the needed endurance for profitable operation on "thin margin" bids.

Uniformity in compressor and engine design makes for compactness and light-weight. Modern engine speeds save fuel costs. Straight vertical construction reduces wear to the minimum. Built-in electric starting on all sizes. Weight reductions as great as 50%.

A size for every need, 40- to 420-cubic foot actual air delivery, Gasoline or Diesel Engine Drive, mounted on steel wheels, pneumatic tires, motor trucks and every conceivable type mounting.

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Make small jobs, as well as larger ones, pay dividends. Reduce non-productive travel time between locations with the mobile MICHIGAN's 25 mph. road speed. Let enthusiastic operators show you how MICHIGAN's Air Controls increase productive time on the job! Here's fast-pace production without let-downs due to operator fatigue. Let the convertible MICHIGAN write a new story of economy and dependability into your cost records. Every MICHIGAN is built from the ground up for hard, tough going. You can handle Shovel, Crane, Clam, Dragline or Trench Hoe work with the same machine — and at a profit! Join the many MICHIGAN owners who are saying "NOW, there's PROFIT in my small jobs, too!" Write for Bulletin CM-11 today.

MICHIGAN AIR CONTROLS

America's Mobile Shovel-Crane Specialists

MICHIGAN POWER SHOVEL CO.

BENTON HARBOR MICHIGAN

(Continued from page 98)

present Columbia River Highway for the hauling roads from these quarries. These underpasses of timber-trestle construction cost about $4,000 each and eliminated danger and delay to railroad and highway traffic and to the contractor's operations.

The cost of the rock toe wall was reasonable and the quarry and haul problems simple, because the precipitous walls of the gorge provided unlimited rock on short downhill haul. In several places the natural talus slopes of the gorge are composed of rock fragments of convenient size for handling, but a major consideration in locating the quarries was to put them where no unsightly scars would be left to mar the scenic beauty of the gorge. The number of such suitable locations was limited.

Rock Borrow Completed

Work was completed last September on a notable rock borrow, operated by G. D. Lyon, of Spokane, about 1 mi. up the river from Multnomah Falls. At this location are long talus runs, which stood on 1½:1 slopes when the contractor moved in. He took out 506,000 cu. yd. and hauled it an average of 1 mi. at a contract price of 28.5c. per cubic yard. This was considered a fair price, because excavation consisted merely loading rock fragments with a 2½-yd. power shovel from the toe of the natural slope into 8-yd. dump trucks. Because of a tendency of the slopes to get steeper when the toe is excavated—some reached ½:1 before the work was finished—it was necessary to operate the shovel cautiously to keep clear of downflow rock. Only occasionally were light powder charges used to jar loose and bring down material that tended to retard the natural flow. The half-million yards of material taken from this quarry were readily available without moving the shovel more than 175 ft. along the slope either way from the center of the borrow. Fines were not excessive, the contract calling for quarry-run, and only very large boulders were shot.

The trucks used to build up the toe wall dumped from a fill whose crest was 20 ft. wide to permit of two-way traffic. The last 5-ft. raise to finish the toe wall grade was back-dumped and the wall completed to top width of 10 ft. with a bulldozer.

On completion of this contract the steeper slopes in the quarry sometimes caused large, flat rocks to come down on edge rolling like cartwheels. It was necessary to build a log crib 26 ft. high and 350 ft. long to prevent these bounding boulders from going on beyond the floor of the borrow and down to the present Columbia River highway and railway tracks below.

Dredged Fill

Part of the dredged fill comes from the ship channel in the Columbia River which is being improved by the federal government from Vancouver, Wash., to Bonneville dam. This was made possible by the

(Continued on page 103)

"THE RIGHT TRUCKS FOR YOUR TRADE"

NEW 1941

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MOST POWERFUL TRUCK ENGINES IN THE LOW-PRICE FIELD

174 FOOT POUNDS TORQUE

90-HORSEPOWER STANDARD ENGINE

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192 FOOT POUNDS TORQUE

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(Optional at extra cost on Heavy-Duty trucks)

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greatly reduces steering effort—brings true passenger car steering ease to truck operation.

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with greatly increased leg room and better, form-fitting seat and back in cabs, giving much greater driver comfort.

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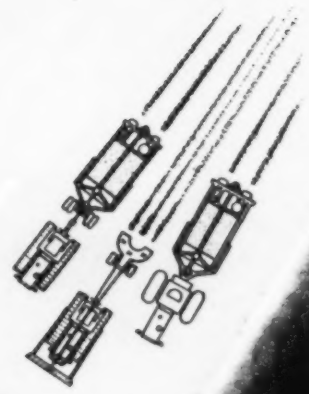
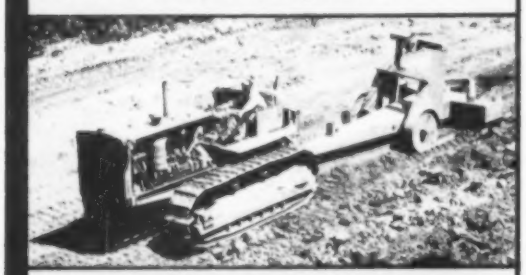
Extra-Capacity Carryalls for Short Hauls
LeTourneau Rooters for Tough Materials



Super C Tournapull bringing 15 heaped yards down a long 25% grade on a bridge approach fill near Peoria, Ill. Complete cycles of load, haul, dump and return on the 6,000-ft. round trip average 9 min. Tournapulls are made in 4 sizes for hauling from 11 to 45 heaped yards.



Heavy-duty Rooter, with two shanks in use, breaking a hard flint and granite rock formation for Carryall loading on Hardaway Construction Company's highway job near Dawson, Ga. LeTourneau Rooters practically eliminate blasting on many jobs . . . cut loading time and profitably increase yardage even in lightly packed soils.

One of 2 Model W Carryalls (23 heaped yards capacity) on W. C. Shepard Company's job near Carrollton, Ga. A LeTourneau Rooter and Pushdozer are used here to make loading easier and faster.

Together They Give You Lowest Net Cost per Yard on All Earthmoving Jobs

Increase your profit margin on 1941 jobs . . . move bigger yardages faster . . . with LeTourneau earthmoving equipment. Here's how:

Increase Tractor Yardage . . . make the power of bigger tractors more profitable . . . put it to work with extra-capacity Carryall Scrapers. 8 big sizes* from 15 to 45 heaped yards . . . in both single and double bucket models. Only LeTourneau makes so many large models to fit your job for the greatest profits. More and more bids are being won by successful contractors on the basis of extra-capacity Carryall operation.

Extend Carryall Profits to Long Hauls with Tournapulls. These outfits pick up heaped loads in a hurry by pusher loading, haul at truck speeds, spread their own loads. You cut investment costs by eliminating the need for expensive loading and spreading equipment. Scores of LeTourneau fleet users have found Tournapull speed the profitable answer to long-haul earthmoving beyond tractor-scraper range.

Increase Carryall Usefulness by shattering shale, hardpan, macadam, concrete slabs, cemented gravel, frozen ground and hard-packed clay with LeTourneau Rooters. You'll save blasting costs . . . cut down loading shocks and strains . . . reduce equipment maintenance costs . . . make Carryall loading easier and faster . . . gain plenty of extra yardage hourly on either tractor-scraper or Tournapull operation. Try it!

Cash in this year with LeTourneau equipment. Ask your dealer to show you NOW how you can increase your profits with extra-capacity Carryalls, fast-moving Tournapulls and heavy-duty Rooters.

Make still more profit from your tractor . . . use it from start to finish of your job.

*Other sizes from 3½ to 12 yards.

LETOURNEAU

PEORIA, ILLINOIS • STOCKTON, CALIFORNIA

SEE NEXT PAGE and

(Continued from page 100)

splendid cooperation of the U. S. Army Engineers. The state has a separate contract with the General Construction Co. for the construction of 3.6 mi. of fill in four sections, totaling 2,600,000 cu. yd. The contract price of 11c. per cublic yard, embankment measure, covers the part of the cost that is in excess of normal spoil-disposal cost. Additional contracts will be awarded later for material to be dredged from sand-borrow areas in the Columbia River adjacent to the fills.

The dredged material is pumped through 22-in. slotted discharge pipes supported on timber trestles. On the river side, where wave wash will occur, a 1:3 slope is being built above the rock toe wall and will be protected with a 3-ft. thick layer of rock riprap. On the back side of the embankment, the slope is to be 1:6 and no protection will be required. The dredge contractors obtain these slopes by building up 5-ft. dikes of the dredged sand with a dragline excavator. Between these sand dikes, successive layers of sand are deposited until finished subgrade elevation has been reached. The contractor has constructed shore-line connections at intervals of approximately 1,500 ft. and output appears to average 17,000 cu. yd. per 24-hr. period.

Deposition of Dredged Materials

In the main, the next contracts will involve the deposition of the dredged materials in sections not subject to wash. Under these conditions the material will be placed on a 6:1 slope and protected by plantings of willows.

A contract was awarded in October for placing rock riprap slope protection as soon as each unit of the fill is completed. Also a quarry-run rock topping 12 in. thick and covering the full width of the roadbed is included in this contract. This serves as a hauling road for the placement of the riprap and as a foundation for a pavement.

A list of the five contracts awarded to date is as follows:

CONTRACTOR	TYPE WORK	CONTRACT PRICE	COMPLETION DATE
Colonial Const. Co.	Rock toe	$129,430	11/30/39
Morrison-Knudsen Co.	Rock toe	89,930	3/30/40
G. D. Lyon & Co.	Rock toe	165,025	10/4/40
General Construction Co.	Dredge fill	314,550	3/15/41*
K. L. Goulter	Rock riprap and topping	67,935	4/1/41*

*Estimated

It is estimated that the cost to complete this 18 mi., after existing contracts, will be $2,700,000, including bridge and paving.

Details described apply to the first 18 mi. of the proposed 70-mile, relocation of the Columbia River highway between Portland and The Dalles. The reconstruction of the 70 mi. to a modern standard will involve the expenditure of approximately $12,000,000. The annual saving to the motoring public using the proposed new Columbia River highway between Portland and The Dalles is estimated to be $1,300,000, which savings will amortize the cost of $12,000,000 for the building of the new water-level road in ten years on the basis of an interest charge of two per cent.

When this magnificent highway is constructed it will be one of the outstanding roads of the West. It will be not only a great commercial arterial route connecting Portland and the Willamette Valley with the rich Inland Empire to the east, but it will also be a road from which the beauties of the spectacular Columbia River Gorge can be viewed from a position hitherto not available. The forest-clad slopes, the tumbling waterfalls, the massive basalt palisades and the high, rocky crags wreathed in trailing clouds can be viewed in safety from this proposed new thoroughfare. Likewise, an intimate view of that mighty river, the Columbia, and the lush, green islands, set like emeralds on its broad bosom, can be enjoyed.

The present Columbia River highway, built more than two decades ago, will be retained as a park road. Relieved of the heavy commercial traffic, this magnificent scenic highway will afford a delightful drive for visitors who enjoy the beauty of Oregon. Joining near Multnomah Falls, the two roads will form a 40-mi. loop drive that will never be forgotten.

* * *

ADAPTING WASHINGTON HIGHWAYS TO *National Defense Needs*

(Continued from page 49)

thirds of the mileage is paved with portland cement concrete 20 ft. or more in width, and much of it of 10-7-10-in. cross-section. Existing bridges, with very few minor exceptions, are designed for H-15 loading and meet the minimum requirements as to clearances.

Existing roads of the second and third priorities quite generally meet the military requirements as to grades and alignment, and a considerable part of the mileage is paved with concrete, but most of the surfacing is of bituminous material. A majority of the bridges are designed for H-15 loading, but there are many on which there are restrictions to 10 tons or less.

Road Widths and Shoulders

The one respect in which the existing roads of each priority fall below the military standards is in overall roadway width and adequate parking shoulders. The present standard adopted in 1938 and approved by the Public Roads Administration requires shoulders 7 to 9 ft. wide outside the paved roadway for highways of the first, second and third class. All recent construction has been in conformity with this standard, but on the major part of the strategic system roadway widths, shoulder to shoulder, do not meet

(Continued on page 104)

Profit from Start to Finish with LeTOURNEAU EQUIPMENT

From initial clearing to final loading of equipment, your tractor can be kept profitably busy with LeTourneau tools.

D8 and LeTourneau Bulldozer uprooting and piling stumps for Rowland-Nash Co., at Mud Mountain Dam in Washington. Fast, sure-acting cable control enables tractor to apply its power three or 4 feet up the tree stump and thus obtain greater leverage. After the stump is loosened, the blade can be lowered under the roots, and both the powerful cable lift and full forward power of the tractor are used simultaneously for uprooting.

LeTourneau Sheep's Foot Roller compacting fill at Pinoplis Dam in South Carolina. These rollers have strong, self-cleaning, non-kicking tapered feet. They come in 2 and 4 drum sizes. Tapered roller bearings make for easy draft.

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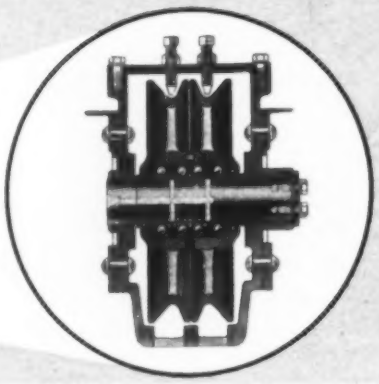

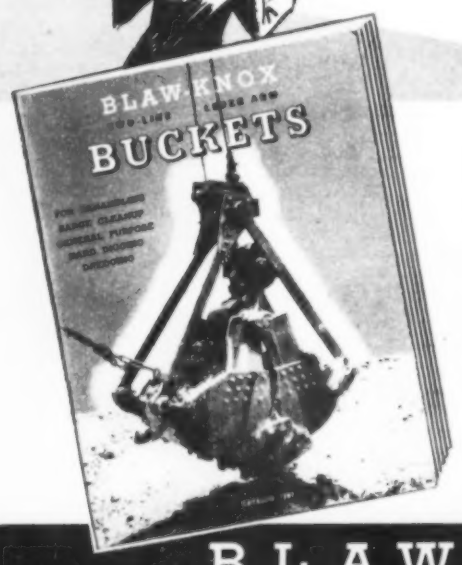

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TREADS WILL PLOW THROUGH

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Shoes bridge space between dual tires, forming a large bearing area in contact with ground, producing positive traction, limited only by the power of your engine.

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(Continued from page 103)

this specification. To correct deficiencies in roadbed and to provide adequate parking shoulders, the estimated cost is about three times that of all other improvements necessary to bring these roads up to War Department standards, and would probably amount to more than $18,000,000.

On existing state highways of the first priority, widening and parking shoulders will constitute more than 90 per cent of the improvement work necessary. About 100 mi. of bituminous surface on U. S. 101 and 60 mi. on U. S. 395 will need to be improved for heavier loading, and minor changes will be required on some of the bridges. One 3-mi. section of road, and a bridge over the Columbia River in the vicinity of The Dalles, will need to be constructed to connect U. S. 97 in Oregon with the same numbered route in Washington. The estimated cost of this improvement exceeds $1,000,000.

To bring roads of the second and third priorities up to military standards will require an estimated expenditure of approximately $18,000,000, or more than 70 per cent of the amount necessary for the outlined strategic system as a whole. Of this sum, about 30 per cent will be needed for grading and minor drainage to meet minimum state specifications; 44 per cent additional for parking shoulders; 20 per cent for improving surfaces and 6 per cent for major structures. Just how soon the program of improvement work will be started, how it will be financed, or with what speed it will be carried on to completion, is not known at the time of this writing (mid-November). Improvements on the strategic system that have been made up to the present, and construction work now in progress, have been financed by the regular state and federal funds without specific reference to the national defense program.

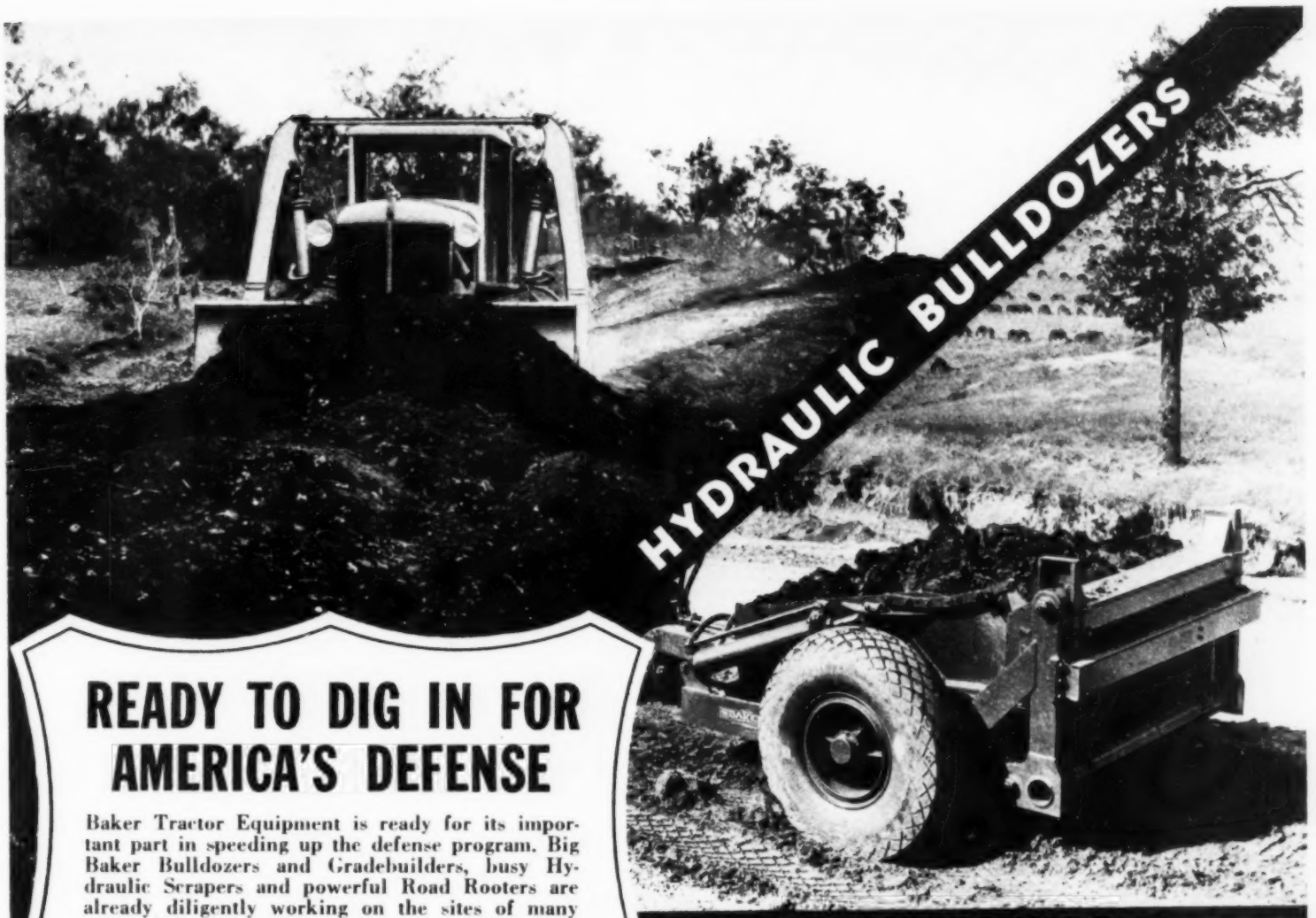
Current Projects

The most important project under way at the present time is that of building a new section of highway, 12 mi. in length, between Vancouver and Kelso, on a relocated part of U. S. 99. The existing road, very crooked, narrow and with some bad grades, has long been inadequate. It constitutes one of the worst traffic bottlenecks on the Pacific Highway between San Francisco and Seattle.

The new road is to have an overall width of 60 ft. in cuts and 64 ft. on fills, with pavement 21 ft. wide on each side of a 4-ft. median strip, to provide two traffic lanes in each direction. On bridges the roadway width is 48 ft., curb to curb. As rapidly as funds for the purpose become available, the work on this project is to be extended to complete a four-lane highway on new location all the way from Vancouver to Olympia, conforming in type of construction to that already completed between Olympia and Everett.

Five contracts have been awarded for work on this 12-mi. section, three for grading and two for bridges. One grading job has been finished and work is in progress on the other four contracts. Under one of the grading contracts the channel

(Continued on page 106)



READY TO DIG IN FOR AMERICA'S DEFENSE

Baker Tractor Equipment is ready for its important part in speeding up the defense program. Big Baker Bulldozers and Gradebuilders, busy Hydraulic Scrapers and powerful Road Rooters are already diligently working on the sites of many great defense projects. Baker Snow Plows are waiting to clear the way for the transportation of materials so that precious winter hours may not be lost. For 32 years Baker has maintained a leading place in the industry. Now, when there is greatest need for its products, we are making every effort to provide equipment which contractors for defense must have.

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★ BAKER TRACTOR EQUIPMENT ★

(Continued from page 104)

of the Lewis River is being changed by dredging, and the dredged material, which is coarse sand, is used for constructing nearly a mile of roadway embankment to form north and south approaches to the Lewis River bridge near Woodland. The early completion of this 12-mi. section should be considered as a national defense measure in preference to the expenditure of funds for improvements on the old road.

On the east-west cross-state routes of the strategic system recent completion of four-lane divided concrete-paved highway on U. S. 10 between Spokane and the Idaho state line, and a concrete bridge with 48-ft. roadway over the Spokane River, is the most notable improvement in line with national defense needs. Also, on this same route a four-lane highway on new location is under construction between Preston and North Bend which will replace the existing narrow crooked road and reduce the distance between these points from 12 mi. to 8. On primary state highway No. 15, a second priority route between Wenatchee and Everett, recently completed contracts and grading and bridge construction now in progress constitute important improvements as measured by military standards.

In addition to improvements on the strategic system, as outlined for military use, a great deal of work has been done by the Department of Highways and by counties, under supervision of the state, in betterment of secondary state highways and county roads, by surfacing with cement concrete or bituminous materials, constructing adequate bridges and eliminating grade crossings.

Many of these roads roughly parallel the primary highways, and in the event of war would serve for much of the lighter military and civilian traffic, so as greatly to relieve congestion on the main arteries, and leave them free for heavy mechanized movements of the army. It is important to the national defense program that improvement of these roads be continued. Funds for the purpose should be provided.

Military Access Routes

In every discussion of highway needs for national defense attention is drawn to the importance of providing roads of access to military and naval concentration points, airports, shipyards, manufacturing plants, etc. Already the need for more adequate facilities of this nature is attaining emergency status, particularly at certain points on the Pacific Highway between Seattle and Olympia. At the Boeing airplane factory, near the south entrance to Seattle, several thousand men are now employed, and with the contemplated enlargement of this plant the number of employees will be greatly increased. As the Pacific Highway is the main access road for this factory there is heavy congestion of traffic at the time of each change of shift. A committee with representatives from the City of Seattle, King County, King County Planning Survey and the Department of Highways is making studies to relieve this condition.

About midway between Tacoma and

(Continued on page 108)

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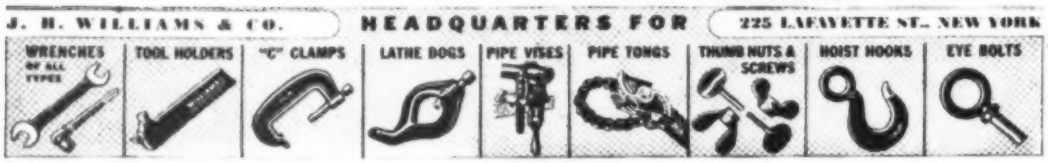

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(Continued from page 106)

Olympia this highway passes through the Fort Lewis military reservation and constitutes the access road to Fort Lewis and McChord Field, the army airport. Construction of a cantonment on the military reservation is under way to provide accommodations for some 14,000 National Guardsmen from Oregon, Washington, Idaho, Montana, and Wyoming, now being mobilized, and preparations are being made at Fort Lewis for receiving conscripted men in the near future. The heavy movement of building materials, army supplies and equipment, workmen and soldiers over and across the highway in this vicinity has already developed into a serious traffic problem, of much concern to both the Department of Highways and military officials.

Widening shoulders and surfacing them with asphaltic concrete and the erection of sodium vapor lights and traffic signals at several intersections with service roads is being done by the Department of Highways, to afford some measure of relief, but additional access roads to the cantonment, and possibly a grade separation at the entrance to Fort Lewis, will be required to accommodate adequately the increasing traffic. These are details which have as yet not been worked out, and for which funds have not at this time been provided.

★ ★ ★

Gradation Control ASSURES AGGREGATE UNIFORMITY

(Continued from page 52)

closed elevator, which conveyed the material to the mixer. Both the apron feeder and the elevator were driven from the mixer power unit and were synchronized with the asphalt metering pump, assuring a constant ratio of mixture ingredients regardless of engine speed.

Continuous Mixer — Designed for ready convertibility to either travel plant or central plant operation, the Barber-Greene heavy-duty pug-mill mixer had been used previously by the contractor in combination with a bucket loader to mix many miles of bituminous road materials on projects set up for processing by a travel plant. At the central plant set-up, the loader served a useful purpose in handling stone out of stockpiles into trucks.

Proportioned aggregate was discharged by the bucket elevator of the gradation unit on to an inclosed apron feeder of the mixer. From the traveling apron, the aggregate dropped through a spray chamber into the pug mill. In the spray chamber the RC-4 cut-back asphalt was applied to the aggregate through five spray nozzles

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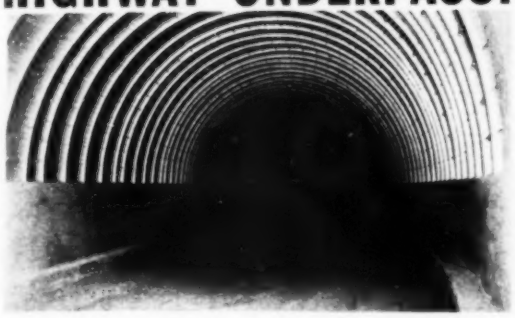

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Among big ratchet wrenches for bridge, structural and erecting work the ARMSTRONG Ratchet stands alone with its *drop forged, heat treated steel handle, its instantly reversible ratchet and hollow center sockets, that are machined from solid steel.* Here are the strongest, longest wearing ratchets made — there is not a casting used, and all moving parts are hardened. They are cadmium plated.

Open spindle and socket permit long bolts to pass thru wrench so nuts can be run any distance on thread, and can be quickly and securely set.

24" Ratchet takes 1" to 2 3/16" Sockets (13 sizes)

36" Ratchet takes 1⅝" to 3⅛" Sockets (11 sizes)

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on a horizontal pipe to which the bitumen material was supplied by a metering pump drawing asphalt from a 700-gal. tank under the pug mill. The metering pump was interlocked with the drive on the apron feeder to maintain synchronous operation. Moving in a continuous stream through the twin pug-mill mixer 8 ft. long, the aggregate and asphalt were thoroughly combined into a homogeneous mixture before being discharged into trucks.

Cut-back asphalt was supplied by gravity to the bitumen tank on the mixer from a 16,000-gal. storage tank at a higher elevation on the site. Temperature of the stored asphalt in the large tank was maintained at about 185-190 deg. F., and the bituminous material was applied in the spray chamber at 175 deg. Specifications required that the temperature of graded aggregate entering the pug-mill mixer should not exceed 110 deg.

Resurfacing Job

Mixed material from the plant was used to put a new surface on two sections of U. S. 50, the 8-mi. stretch of old asphalt macadam at an average distance of 31 mi. from the quarry and shorter ½-mi. section on new location about 23 mi. from the plant. Of the 8-mi. section, about half was on a continuous grade on Allegheny Mountain; this portion of the job involved many sharp curves, of which six were 60 deg., and maximum grades of 7 per cent.

Prior to resurfacing, old 18-ft. asphalt macadam on the 8-mi. section was widened by addition of new crushed rock base along the edges. On tangents, the roadway was widened to 20 ft. by construction of two 1-ft. edge strips; curves were flattened as much as possible by widening to from 22 to 30 ft. on the inside. New crushed rock base widening was primed with RC-1 cut-back asphalt, but no prime was required on the bituminous macadam.

A Barber-Greene tamping-leveling finisher placed all the resurfacing material, including the patching mixture used to fill depressions in the old macadam. The machine worked on one side of the road at a time, placing the material in a 10-ft. strip and leaving the other side clear to pass traffic during all stages of construction. Binder course was laid at a rate of 100 lb. per square yard, and top course at a rate of 75 lb. per square yard.

Behind the spreading and finishing machine, the material in each course was compacted by a Buffalo-Springfield 10-ton three-wheel roller. The top course was covered with a dry seal of stone screenings at a rate of 6 to 8 lb. per square yard, applied by a Buckeye roll spreader which was closely followed by a drag-broom and a Fordson 5-ton roller. Stabilized shoulders 6 ft. wide were constructed on both sides of the pavement, using a curious local product — a burned shale excavated from above a burning coal vein.

Quantities and Prices

Patching of the existing asphalt macadam to take out surface irregularities required about 1,000 tons of plant-mix

(Continued on page 110)

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(Continued from page 109)

material. For binder and top courses, the respective quantities required were about 5,100 and 4,000 tons.

Contract prices on the various materials included the cost of producing and placing the finished mixtures in the pavement. RC-4 cut-back asphalt used in all mixtures was bid at 8c. per gallon. Aggregate for patching was priced at $4 a ton, and aggregate for binder and wearing course at $3.75 a ton. The unit price of stone screenings for dry seal was $5 a ton. Total value of the contract was about $79,000.

Design of Mixes

Depending on the depth of the depressions in the old pavement, patching mixture was made up with either ¾-in. to No. 4 stone or ½-in. to No. 4 size. The designed proportion of bitumen in the patching material was 3.3 per cent, but some depressions requiring the smaller stone were filled with top-course mixture containing the proper size of aggregate and 4.25 per cent bitumen.

An accompanying table indicates the aggregate gradation for binder course mixture. A designed grading falling within the limits of the required gradation was selected by the plant inspector to fit the characteristics of the aggregate avail-

BINDER COURSE AGGREGATE
WEST VIRGINIA No. 5 STONE
PER CENT PASSING

SCREEN OR SIEVE	Required gradation	Designed gradation	Variation in samples
1½-in.	100	100	nil
1-in.	90-100	98.3	(a)
¾-in.	40-75	59.9	58.5-60.0
½-in.	5-20	11.2	10.9-12.0
⅜-in.	0-10	4.4	3.9-4.4
No. 4	0-5	1.3	0.9-1.3

(a) Practically no variation

able from the crushing and screening plant. Once the gradation unit had been adjusted to deliver the designed grading, the aggregate proportions remained practically constant. A final column of the table indicates how slight were the variations in the established grading during the mixing of 5,100 tons of binder. Asphalt cutback was added by the metering pump at a rate to give the mixture a bitumen content of 3.04 per cent. Later paragraphs will describe the plant inspector's procedure in establishing the grading for binder course mixture.

Original top course design called for use of West Virginia No. 10 aggregate, of nominal No. 4 to ½-in. size. For this mixture the laboratory suggested 4.2 per cent bitumen, and the proportion actually added at the plant was 4.25 per cent. After about 3 mi. of top had been laid with this material, the design was changed to produce a more densely graded mixture.

A second table gives the aggregate gradation for the latter mix. One column shows the gradation suggested by the laboratory as a maximum to be approached as closely as possible in the field. The final column indicates actual gradation worked out by the plant inspector as the closest approach attainable without slowing down production. The laboratory rec-

(Continued on page 112)

This Contractor says . . .

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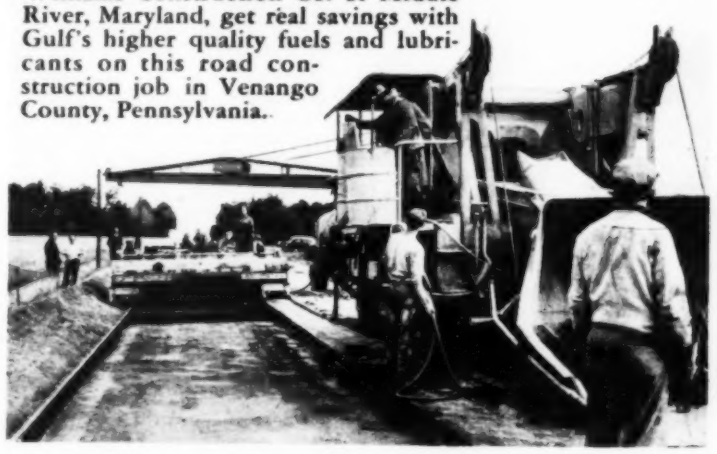
Williams Construction Co. of Middle River, Maryland, get real savings with Gulf's higher quality fuels and lubricants on this road construction job in Venango County, Pennsylvania.



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Year after year Marmon-Herrington *All-Wheel-Drive* converted Fords have proven themselves veritable "little giants" in all sorts of general construction and road work. 1941 models are better yet, because they incorporate all the improvements in design and construction which have been developed through the years by The Ford Motor Company, and by Marmon-Herrington engineers. Truly, there are no other trucks, at any price, which can surpass these powerful, fleet and economical vehicles for performance when the "going" is really tough.

We convert all standard Ford trucks, passenger cars and commercial vehicles to *All-Wheel-Drive* in the same plant where Marmon-Herrington heavy duty *All-Wheel Drive* trucks are built. Write for literature on any or all of these vehicles, and ask for a demonstration by our dealer in your territory. You will be amazed at what these vehicles will do, and agreeably surprised at the low prices. Cable address MARTON.

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(Continued from page 110)

ommended 5 per cent bitumen for the dense graded top mix, but experience in the field showed 5.15 per cent to be better, and this was the percentage used.

In all mixes, the gradation of aggregate remained constant within limits as narrow as those shown in the table for binder course. A description of the plant inspector's procedure in calibrating the gradation control unit and adjusting the plant for binder course mix will indicate the method followed in all cases.

DENSE WEARING COURSE AGGREGATE GRADATION

SCREEN OR SIEVE	PER CENT PASSING: Maximum suggested	PER CENT PASSING: Actual
½ in.	100	100
⅜ in.	78	70.7
No. 4	31	28.9
No. 8	17	13.9
No. 20	8	5.7
No. 40	5	3.8

Calibrating Procedure

Material from each of the three bin compartments in the gradation control unit discharged through an accurately calibrated and individually controlled gate on to the apron feeder. To assist in measuring the discharges through the gate, a by-pass chute was provided under the apron feeder to enable the operator to draw off samples of the separated classes of aggregate into a special three-compartment steel box supplied with the gradation unit.

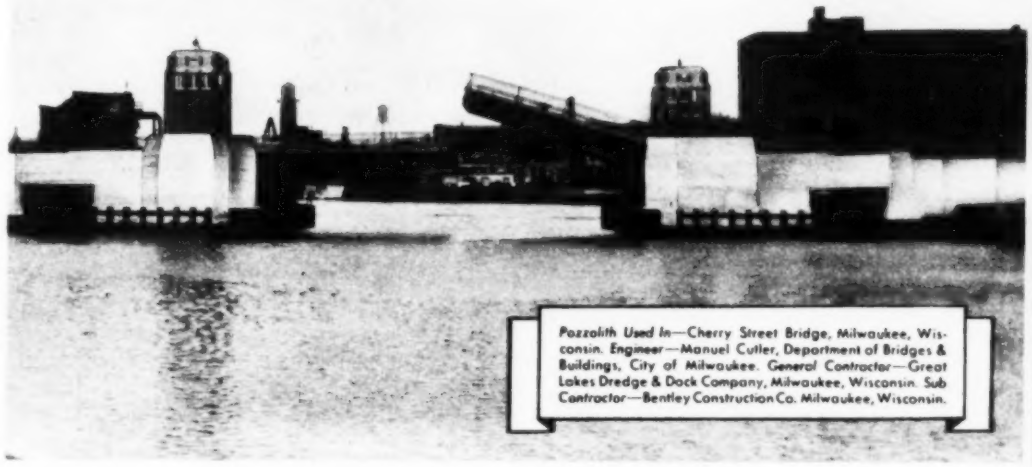
As an aid to calibrating, a revolution counter is permanently attached to the feeder foot shaft of the unit. With the Buda 125-hp. gasoline engine of the mixer governed at its normal operating speed, the counter registers 16.07 r.p.m. The counter thus provides a means for calibrating the continuous flow of aggregates and the continuous flow of bitumen to the same measurement of time or number of revolutions. When set, the relation of the bitumen, the aggregates, and the counter remains constant even though the governor speed of the engine varies slightly.

To determine the output through the gate of each particular material, the gates were opened at successive increments of from 2 to 7 in., and for each gate opening the apron feeder was operated long enough to provide a good test sample. The three separated materials drawn off in each operation and trapped in the steel box were weighed individually. These weights then were divided by the number of revolutions recorded on the counter, giving the number of pounds of material per revolution per gate opening. From the results of these tests, graphs were plotted showing weight of material per revolution against gate opening for each bin of graded material.

As the next step, material samples were taken from the three bins and put through screen analyses. On the basis of these analyses, the inspector determined by trial and error the proportions which should be drawn from the three bins to meet the grading requirement of No. 5 aggregate without wasting any of the material sup-

(Continued on page 114)

HOW TO GET *High Early Strength* WITH *Regular* PORTLAND CEMENT



Pozzolith Used In—Cherry Street Bridge, Milwaukee, Wisconsin. Engineer—Manuel Cutler, Department of Bridges & Buildings, City of Milwaukee. General Contractor—Great Lakes Dredge & Dock Company, Milwaukee, Wisconsin. Sub Contractor—Bentley Construction Co. Milwaukee, Wisconsin.

SAVE TIME. You can get 3 day strength in 1 day, 7 day strength in 3 days, and 28 day strength in 7 days, using High Early Pozzolith in Regular Portland Cement purchased at economical prices.

By adding High Early Pozzolith, cement-dispersing, water-reducing agent, at time of mix, you reduce the excess water normally required, nevertheless you get *greater* placeability of concrete, far less segregation and honeycombing.

SAVE MONEY. With High Early Pozzolith speeding up the curing of concrete you can strip forms faster, and require less forms. You can reduce excessive pointing-up and rubbing, and check honeycombing, segregation, bleeding.

High Early Pozzolith creates a more efficient flow in pumpcrete, and greater uniformity. It reduces the hazard of line stoppage when pumpcrete is temporarily halted.

SAVE REPAIRS. Through effective cement dispersion and drastic water reduction High Early Pozzolith produces concrete of minimum porosity, shrinkage, cracking, and permeability. Pozzolith concrete is watertight because it attacks the cause of leakage correctly — by reducing excess water in the mix.

Use High Early Pozzolith now, — when cold weather hazards demand quick curing. Use High Early Pozzolith to get that job finished — and accepted on time.

For additional details write —

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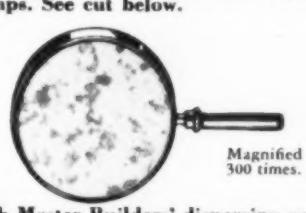
Cleveland, Ohio **Toronto, Canada**

Add HIGH-EARLY Pozzolith *Save Time Save Money*

How POZZOLITH *Improves Concrete*

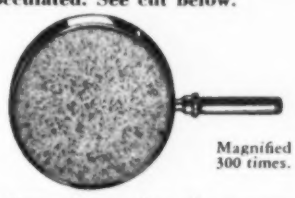
POZZOLITH contains a cement dispersing agent (patented)

Cement particles in their normal state in water tend to gather together in bunches; i.e., flocculate. This bunching entraps water within the particle clumps. See cut below.



Magnified 300 times.

With Master Builders' dispersing agent these bunches are broken up into individual cement particles distributed through the water; i.e., dispersed or deflocculated. See cut below.



Magnified 300 times.

This dispersion makes the cement usable to its full efficiency; all the cement surface is made available for hydration and all the water for lubrication of the mix. (Water held within the particle clumps is released.)

As a result of adding a dispersing agent to cement there occur, —

- ***Greater workability with less water.***
- ***Increased strength.***
- ***Watertightness.***
- ***Increased durability (higher resistance to freezing, thawing, and corrosion).***

The complete story of Cement Dispersion is available in Research Paper No. 35. Send for this explanation of a revolutionary forward step in better concrete.

MASTER BUILDERS

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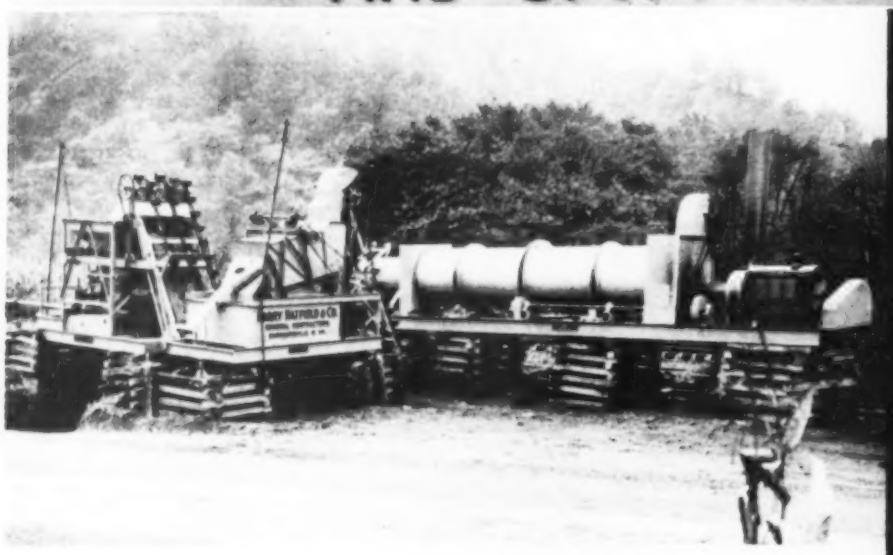

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Will cut any slope that a shovel can dig through.
Controlled entirely from operator's seat.
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(Continued from page 112)

plied to the gradation unit. In the case of the binder aggregate, all requirements were met by blending 40 per cent from the coarse material bin and 30 per cent from each of the other two bins. The gates accordingly were set to deliver material in these proportions and in the quantities required to maintain the desired ratio with the inflow of bitumen into the mixer.

As already noted, the asphalt metering pump was synchronized with the apron feeder. To adjust the asphalt input into the mix, sprockets on the pump drive were quickly changed to give the nearest approach possible to 3 per cent bitumen for a plant output rate of 80 tons. The actual bitumen input obtained in this way exceeded the theoretical 3 per cent for 80-ton capacity, and the flow of aggregate accordingly was stepped up slightly above the 80-ton figure to hold the bitumen content of the mixture to 3.04 per cent. As a check against variation in aggregate gradation, samples were taken from the bin compartments and tested by screen analyses one to three times each day.

Calibration by the process described above provided a simple means for the engineer at the plant to set up the mix based on tests of the actual materials to be used. Once set, the measuring and mixing were automatic, eliminating the uncertainty of the human element in mix control.

Drying Aggregate

Dense aggregate for top course sometimes contained up to 6 per cent moisture after standing in stockpile during wet weather. The twin dryer drums, 20 ft. long by 54 in. in diameter, each equipped with a Hauck steam-atomized oil burner, removed all surface moisture and reduced contained moisture to 1 per cent or less, as required by specification, without raising aggregate temperature much above 135 deg. Aeration of the aggregate on its 50-ft. conveyor trip helped to reduce the temperature to meet the specified maximum of 110 deg. when entering the pug mill.

Hauling Fleet

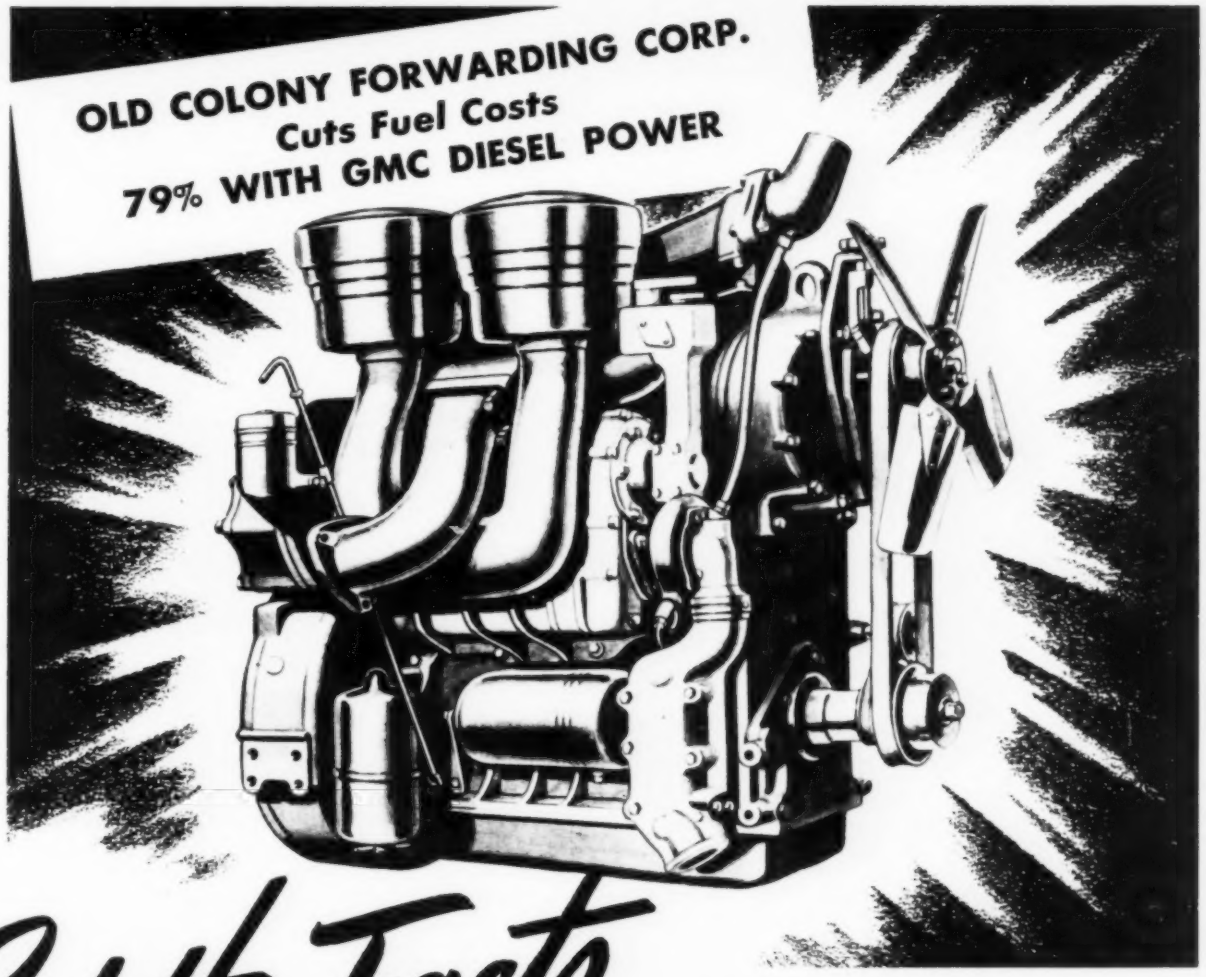
Hauling from the plant to the road was handled on a ton price basis by a subcontractor who supplemented a small fleet of his own with hired trucks. The trucks, carrying average loads of 6½ tons, were weighed on a platform scale as they left the plant. Shortage of trucks prevented the plant from maintaining full production.

For the long haul, as many as 40 trucks could have been used to advantage. The maximum number available on any one day was 30, and the average was between 22 and 25. Loaded one-way haul to the road required 75 to 90 min., with somewhat shorter time for the return trip.

Plant Output

Because of the lack of sufficient trucks, the plant was unable to operate continuously throughout the day. Laborers were employed on two 6-hr. shifts, but the plant and the paving machine ordinarily worked considerably less than 12 hr. per day. During the fall, as the days grew shorter, the average daily working period was

(Continued on page 116)



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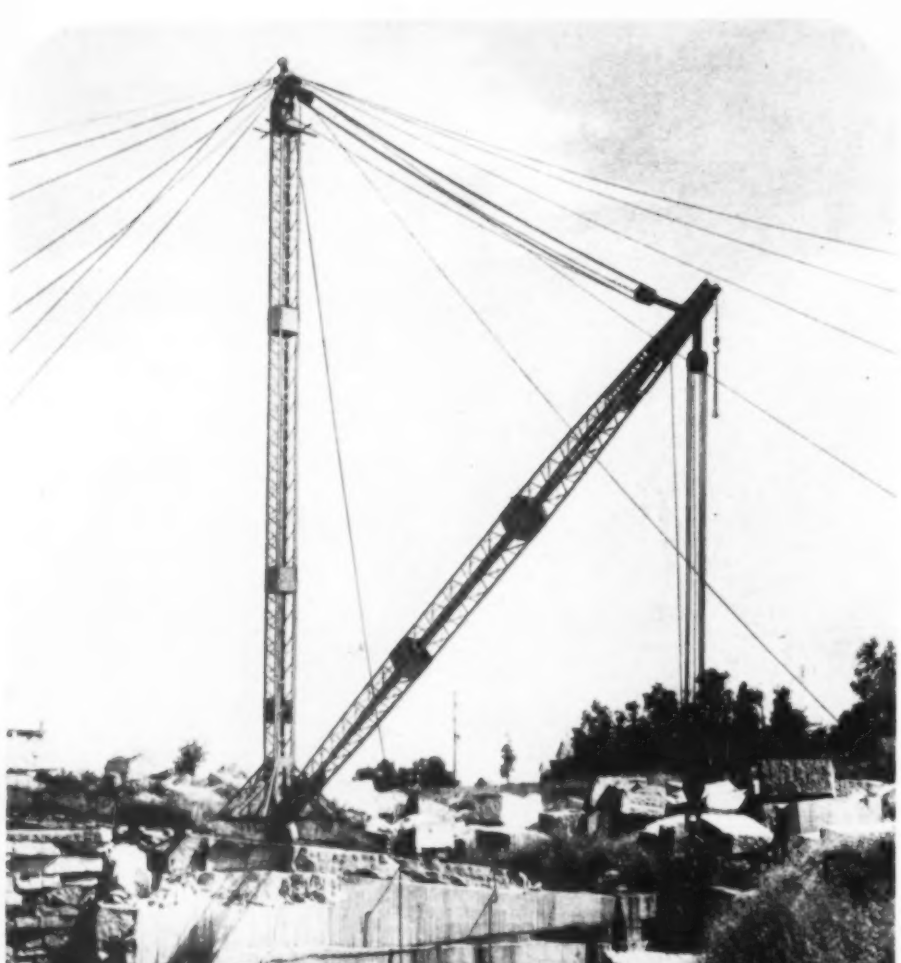

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write for CATALOG D1

(Continued from page 114)

about 8 hr., in which the trucks were able to haul about 400 tons.

Work on the project was begun the middle of August, and the plant started mixing binder Sept. 17. Laying of top course was completed the first week in November. The maximum day's output was 492 tons, although the contractor is confident that with better hauling conditions the plant and paving machine could easily have put down 600 to 700 tons per day. Plant production attained its best hourly average during one morning when 400 tons of material was mixed in 6 hr.; rain shut down the plant at noon that day. Average daily production for the entire job was about 420 tons.

Administration

For the Murphy Construction Co., Morgantown, W. Va., headed by Thomas Murphy, president and general manager, the job was built under the direction of Paul A. Feather, assistant manager, with George Lipscomb, superintendent, in charge at the site. Production of paving mixtures was supervised for the West Virginia State Road Commission by A. M. Miller, assistant materials engineer, and H. B. Wilson, plant inspector. The resurfacing was under the direction of B. D. Johnson, construction engineer, C. R. Nuzum, resident engineer for District 5, and H. C. Manning and Lorentz Smith, inspectors. Burr H. Simpson is state road commissioner, and E. N. Blackwood is state construction engineer.

* * *

Mercury Vapor Lamps LIGHT TURNPIKE TUNNELS

(Continued from page 69)

ing from a battery source in case the main power system is interrupted, is provided in the tunnels. Emergency fixtures are spaced 300 ft. apart in alternate rows, and provide sufficient illumination for discernment of normal hazards in the tunnels. The seven tunnels are served by 242 emergency units. Batteries are charged by gasoline-engine-driven generators.

Interiors of ticket offices are illuminated with fluorescent lamps. Two fixtures, mounted flush with the ceiling, employing a total of four 40-watt white lamps, are used in each office. They provide 45 foot-candles on the ticket seller's desk. Metal louvers diffuse the light, no glass being used.

Outside areas under the marquee which covers the driveway spaces are illuminated by incandescent units, flush mounted in

the marquee ceiling. Six units are used at every drive entrance, 5 of these being 200-watt fixtures, square in shape and employing special glass for distributing the light output properly.

Each mercury-vapor lamp in the tunnels is operated from the secondary of an individual transformer. Primaries are connected across a 2,300-v. 60-cycle multiple circuit. Sodium butterfly luminaires are connected in series on a constant current circuit through 6.6-amp. regulators, the primaries of which are connected to the power company's supply lines. Other lighting circuits are fed by parallel circuits through step-down distribution transformers. Total lighting load is 375 kw., supplied by four power companies along the Turnpike's route.

* * *

Spreader-Vibrator SPEEDS CONCRETE FINISHING

(Continued from page 63)

spreading and vibrating simultaneously on one trip, in no way detracting from construction progress or slab production.

Another photograph illustrates the condition of the slab surface after vibrating, as compared with non-vibrated concrete. Vibration compacted and sealed the surface so effectively with mortar that little work was required of the finishing machine which traveled close behind the spreader-vibrator. This surface effect was of advantage in expediting the work of the cement finishers, who could follow the finishing machine closely to complete their operations, including edging and jointing, without the long overtime hours required on non-vibrated slab.

Use of the vibrator attachment on the U. S. 20 job was a direct result of the enterprise of Robert E. O'Connor, president, J. C. O'Connor & Sons, Inc., who had purchased two Blaw-Knox transverse blading spreaders for this work after observing the effectiveness of the machines in overcoming segregation and aiding progress on the Pennsylvania Turnpike. Knowing that vibrators could be installed on the spreaders, Mr. O'Connor late in the summer interested the Indiana Highway Commission in making a test of vibration on the U. S. 20 project, with the results outlined above. The vibrator attachment also has been used with spreaders in Pennsylvania and Ohio.

M. R. Keefe was chief engineer of the Indiana State Highway Commission until December, when Earl B. Lockridge, formerly assistant chief engineer and engineer of construction, succeeded him. In the La Porte district, where the test was made, F. E. Bernoske is district engineer, and R. F. Berns is assistant district engineer of construction.

FAST GRADING AND PAVING Save One Year

(Continued from page 62)

to elliptical section, and the struts were released after the culverts had been placed under load to allow the pipe to assume its normal circular section. Other culverts utilized reinforced-concrete pipe, 12- to 72-in. diameters, and box structures 2x2 ft. to 9x7 ft. in size. Two stream crossings are bridged by reinforced concrete T-beam spans 36 ft. and 45 ft. long, carrying a roadway deck 48 ft. wide.

Grading Operations — Earth - moving equipment responsible for the rapid progress on grading included three power excavators, eighteen tractors, six carrier scrapers and twelve trailer wagons (six mounted on steel tracks and six on pneumatic tires), in addition to six Euclid pneumatic-tired tractor-wagon bottom-dump units. In sandstone and shale cuts, encountered chiefly in the easterly 3 mi. of the job, the contractor used compressors and drills to sink blast holes. About 140,000 cu.yd. of rock and hard shale was blasted. Some of the shale could have been moved by rooters and scrapers, but the blasting saved time in excavating.

Two 2-yd. diesel shovels, a Bucyrus-Erie and a Lorain, loaded tractor-wagon trains in the earth and rock cuts. On excavation for stream changes the contractor operated the Bucyrus-Erie shovel and a gasoline-powered Northwest 2-yd. dragline. Each of the tractor-wagon trains hauling from the shovels was made up of a Caterpillar 96-hp. diesel tractor pulling two units in tandem, an Athey 14-yd. track wagon followed by a Euclid 12-yd. bottom-dump body mounted on two wheels equipped with pneumatic tires. When loading out of rock cuts, the shovel operator deposited the large rock fragments in the track wagon and placed the finer material in the bottom-dump trailer unit. This disposition of the material facilitated dumping and avoided damage to the wagons.

A combination of track wagons and pneumatic-tired wagons behind the tractors was regarded by the contractor as an aid to greater earth-moving output per unit of equipment. According to this view, the combination of wagon units makes it possible to increase output without producing overload conditions which cause delays and breakdowns. On hauls up to 1,000 ft., four tractors drawing tandem wagons were able to keep a 2-yd. shovel busy.

Grading equipment worked two 7-hr. shifts per day. With the two shovels and the dragline operating under average conditions, the three excavators were able to handle 5,000 cu.yd. in 14 hr.

A fleet of six Le Tourneau scrapers, five 14-yd. units and one 10-yd. unit, powered by Caterpillar diesel tractors of 96-hp. drawbar capacity, operated on average

(Continued on page 118)

Made originally for use in AMERICAN Hoisting machinery. Genuine CROSBY Wire Rope CLIPS are designed and made for greatest safety.

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Girder-Trussed

The new Hercules Girder-Truss Brace supports body sides in the most efficient manner – AT THE TOP. This type of support, used exclusively by Hercules, keeps top edge of body straight so that there can be no spread or sag of body sides without stretching the metal itself.

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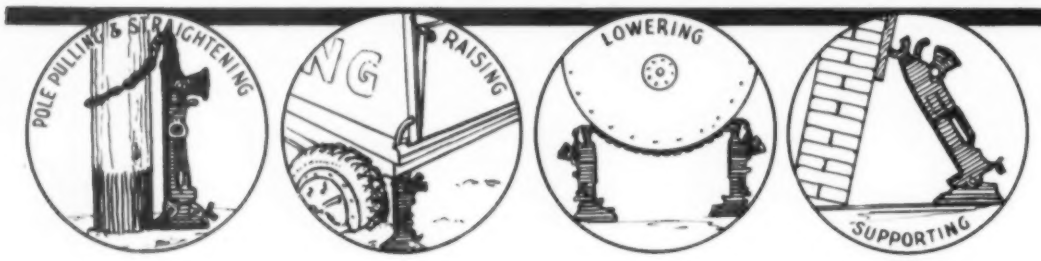
GALION, OHIO



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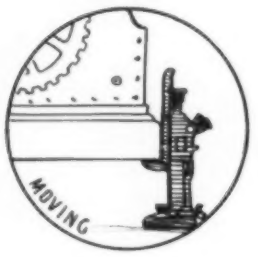


SIMPLEX Jacks
Awarded the Gold Medal for Safety

Send for Simplex Catalog 40.

(Continued from page 117)

one-way hauls of 400 to 800 ft. Excavating good material, such as sandy clay, the scrapers ran up daily records exceeding 9,000 cu.yd. in 14 hr. With all excavating equipment on the project working under favorable conditions, the job was able to move as much as 15,000 cu.yd. in one day. The labor force engaged on the two shifts totaled about 145 men.

Fills were built up in 8-in. layers with close control of moisture and compaction to obtain required high densities. Compaction requirements varied slightly for fills of different heights, the greatest percentage of maximum density being speci-

(Continued on page 120)

DAILY PAVING RECORD

Six Side-Discharge Truck Mixers
Batch Size, 2.66 Cu.Yd.
Hussey & Holderman, Columbus, Ohio

Date	Paving Hours	No. Batches	Lin.Ft. 11-Ft. Slab
JULY			
25	4½	43	480
26	8	140	1439
29	8	170	1682
30	8	142	1438
31	8	171	1742
AUG.			
1	8	174	1741
2	6	134	1441
3	4	89	932
5	4	57	700
6	7½	174	1860
7	7	180	1920
8	8	172	1860
9	8	203	2160
10	8	167	1740
12	7	83	890
15	8	189	2050
16	5½	125	955(1)
17	7	115	1250
19	5¾	110	1202
21	7½	133	1442(2)
22	7	143	1091(3)
23	8	182	1912
24	8	180	1916
26	9¾	190	1980(2)
SEPT.			
4	8	146	1560(4)
5	8	172	1860
6	8	167	1726
9	6	157	1672
11	8	207	2206
13	8	184	1980
14	8½	198	2281
17	8	163	1761
18	4	70	762
19	8	181	1860
20	6	126	1320
23	8	186	1967
24	6	161	1670
27	8	211	2267
28	6½	180	1919
30	8	199	2339
OCT.			
1	9½	230	2404
See note (5) below.			

(1) Also 551 sq.yd. of 6-in. approach pavement.

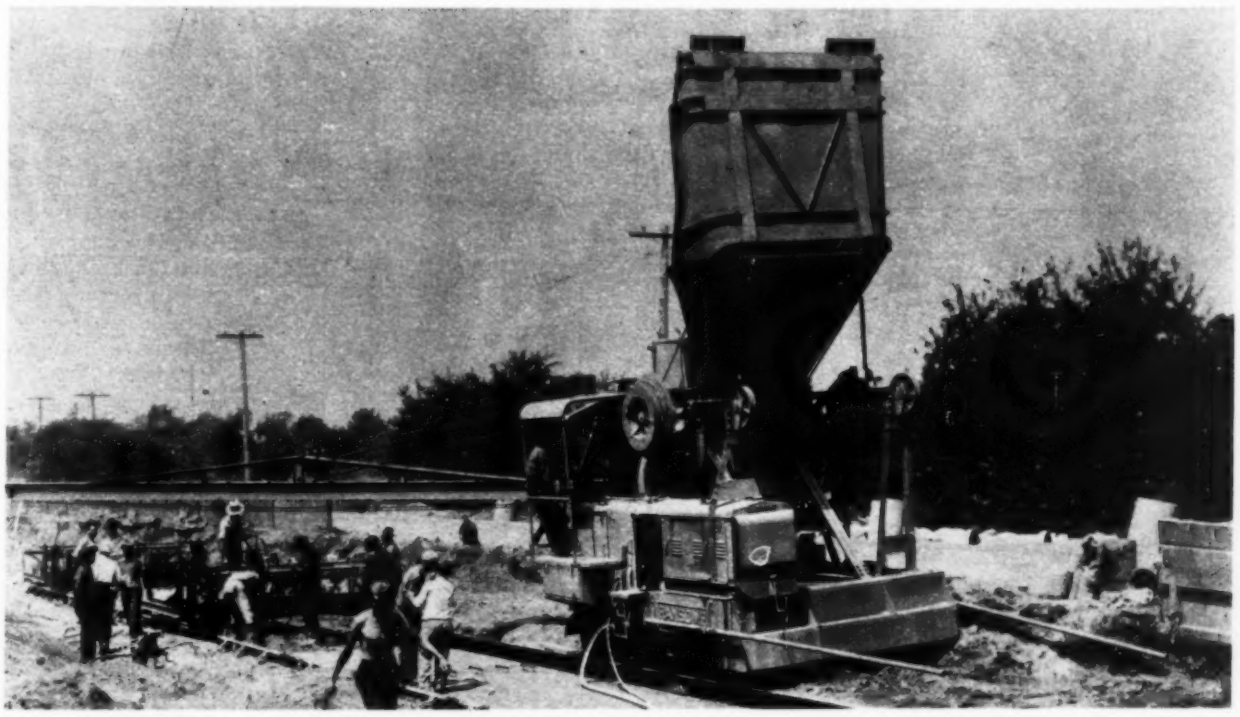
(2) 10,000-ft. one-way haul.

(3) Also 542 sq.yd. of 6-in. approach pavement.

(4) Only five truck mixers hauling; average haul, 7,500 ft.

(5) From Oct. 2 to Oct. 10, inclusive, paving was almost entirely on incidentals — driveways, traffic lanes, etc. During this period, truck mixers in 30½ paving hours delivered 351 batches for 742 lin.ft. of 11-ft. slab and 3,993 sq.yd. of 6-in. approach pavement.

The Latest Contribution to Paving Economy

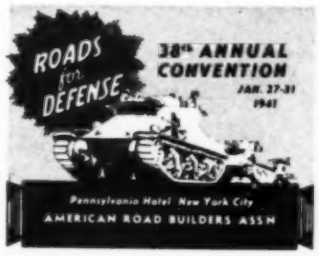


The Ransome 34E "Single Drum" Paver

RANSOME offers the 34-E "Single Drum" Paver for average sized jobs where the capacity of the Ransome 34-E "Dual Drum" Paver is not required. This latest achievement of Ransome engineers has inherited all of the advantages of the universally known Ransome Pavers and in addition makes economy on average paving jobs a reality.

NOTE THESE FEATURES:

- Interchangeability of many parts with the 34-E "Dual Drum" Paver.
- Large engine operating at a slow speed for long trouble-free engine life.
- Full Hydraulic "Finger Tip" controls for easier and smoother operation of boom swing, water valves and discharge chute.
- While a spreading reach of 32½ feet is retained, less counter weight is used than on standard 27-E due to better balance and longer crawlers.



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RANSOME CONCRETE MACHINERY COMPANY

DUNELLEN, NEW JERSEY

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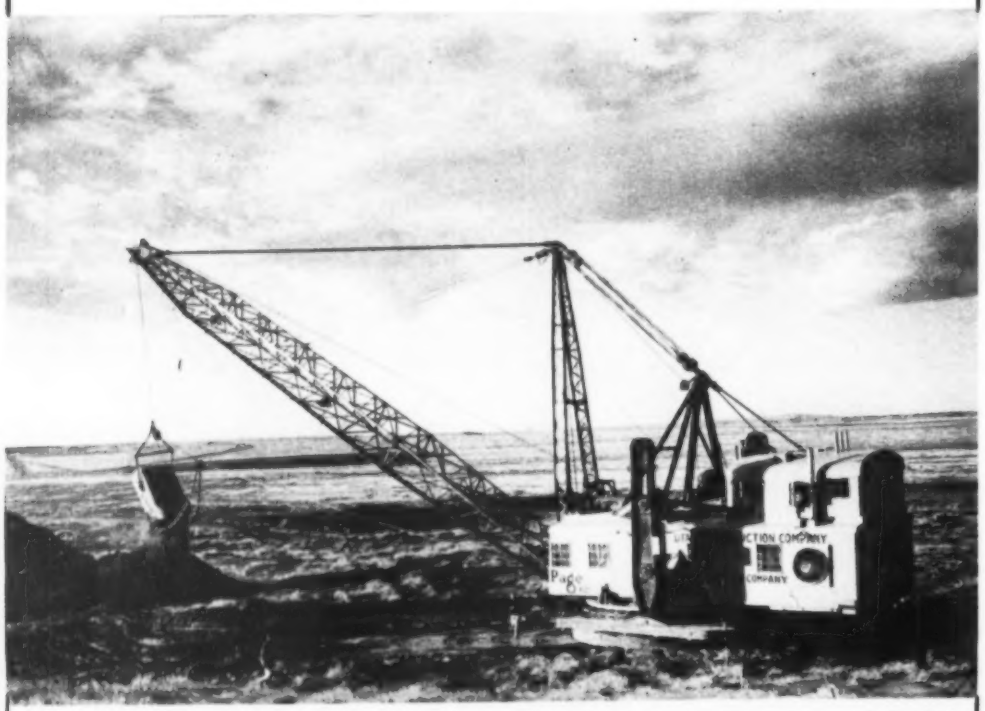
One engine for loading and hoisting
Another separate engine for swinging



On canal work near Tucumcari, New Mexico, Utah Construction Company and Griffith Company use this Page Walker, powered by two Page horizontal Diesels, one mounted above the other. A heavy-duty 6½-cubic-yard Page Bucket is used on a 110-foot boom.

Here is a new development in large draglines—fast hoist and fast swing at the same time! No longer need the operator delay the swing of the machine waiting for the hoisting of the bucket. Rather, with the balanced power of the Page Two-Engine Walker, acceleration of hoisting and swinging is greatly increased.

To understand this faster operation with a Page Two-Engine Walker, visualize using all of the power of your present dragline for hoisting only, without swinging the machine. You will find that the hoisting speed will be increased greatly. Now consider a second independent engine for swinging only. This second engine accelerates the swing in proportion to the faster hoist. The two engines—the large Diesel, which only hoists and loads the bucket, and the smaller independent Diesel for swinging as rapidly as the faster hoist demands—furnish perfectly balanced power and increase the number of loaded buckets that can be handled per minute. Learn what a Page Two-Engine Walker will do on your dragline job.

PAGE ENGINEERING COMPANY

Page Automatic Dragline Buckets · Page Walking Dragline Machines

CLEARING POST OFFICE, CHICAGO, ILLINOIS

(Continued from page 118)

fied for the higher fills. Additional moisture was applied where needed with tank trucks, and each fill layer was compacted with tractor-drawn Le Torneau sheepsfoot rollers. Six trips with a roller ordinarily produced desired compaction.

Paving Plant

High-speed paving operations of the Hussey & Holderman organization were built around six Jaeger side-discharge mixers of 2.9-cu.yd. drum capacity, mounted on International trucks, and a fast-charging Heltzel 120-ton batching plant equipped to handle sand and two sizes of coarse aggregate. The 22-ft. pavement, 9-7-7-9-in. cross-section, was placed in two 11-ft. lanes by a Jaeger screw spreader which received the concrete from the side-discharge mixers and distributed it between the forms in two courses, the first course being struck off 2 in. below finish grade to support reinforcing mesh installed in the slab.

Paving methods employed by the contractors on this work were in no sense an innovation but were the result of two years' experience with truck mixers. To facilitate sack batching of cement, the size of the concrete batch for the job was set at 2.66 cu.yd., containing 16 sacks. Experience had shown that the economical haul limit from the batching plant for a fleet of six mixers handling batches of this size was about 2 mi. Accordingly, the contractors selected two side-hill locations for the batching plant, about 8,000 ft. from each end of the project, and hauled two ways from each site. Maximum haul from each location was less than 2 mi.

To maintain uniform delivery of concrete to the spreader it was essential that the time consumed in loading a mixer at the batching plant should not exceed that required to discharge the batch on the road. The batching plant was designed to complete the charging of a mixer, including removal and replacement of the hatch, in 60 to 90 sec. As the discharging operation at the spreader was equally fast, the fleet of six truck mixers was able to deliver up to 26 batches per hour on the shorter hauls, equivalent to concreting 11-ft. lane at the rate of 290 lin.ft. per hour. Paving rates for the job varied from 200 to 290 lin.ft. per hour and averaged about 230 ft.

Batching Set-Up

At each location of the batching plant the contractor set up a portable 120-ton bin equipped with three compartments to which end-dump trucks could deliver sand and two sizes of coarse aggregate by backing over a bridge from a hillside access road. The three aggregates were weighed by beam scales, cement was measured out of sacks, and water was metered in a tank. All the ingredients of the mix dumped simultaneously into the mixer drum.

A workman stationed on an elevated portable platform adjacent to the plant removed and replaced the drum hatches. As a truck mixer approached the plant, it stopped at the platform to allow the hatch to be opened before backing under

(Continued on page 122)

New York specifies BLACK TOP • BLACK BASE

for 10 Miles of State Highway

In this 10-mile New York State highway project, a TEXACO Asphaltic Concrete surface (cold laid type) is being laid on a TEXACO Asphalt Macadam base (penetration type).

The TEXACO Asphaltic Concrete surface was laid on half the width of the highway at a time.

A view of the finished TEXACO Black Top • Black Base highway before completion of the shoulders.

New York State recently indicated its opinion of BLACK TOP • BLACK BASE highways when it chose this type for 10 miles of State Highway in Greene and Ulster Counties.

A BLACK TOP • BLACK BASE highway is resilient from sub-base to surface. This important shock-absorbing quality adds to its life and reduces maintenance cost. The bond which forms between a BLACK BASE and a BLACK TOP is so perfect that the two courses virtually become one. This is another characteristic which makes for greater durability.

For its 10-mile BLACK TOP • BLACK BASE project, New York State chose an asphalt macadam foundation constructed by the penetration method. The wearing surface is asphaltic concrete of the cold-laid type. More than 400,000 gallons of TEXACO Asphalt went into the building of this highway, New York State's second largest asphalt project of 1940.

For engineering assistance in designing a Black Top • Black Base street or highway, write our nearest office.

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The book tells you:

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- how to make road surveys
- how to handle drainage problems
- how to control erosion
- how to establish efficient grades
- how to design rural highways
- how to lay out street pavements
- how to treat earth roads
- how to construct sand-clay, topsoil and gravel roads
- how to place stone in water-bound macadam roads
- how to use road slabs of concrete, etc., etc.

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(Continued from page 120)

the bin. A second stop on the return trip closed the hatch.

A 2.66-cu.yd. batch contained the following dry weights of materials: 1,504 lb. (16 sacks) of cement; 3,040 lb. of sand, 2,480 lb. of small gravel (4-mesh to 1 in.) and 3,024 lb. of large gravel (4-mesh to 2½ in.). To supply a deficiency of fines in the river sand used on the job, 190 lb. of fine silica sand was included in the 3,040-lb. of sand required for each batch. The plant operator drew 2,850 lb. of sand out of the bin compartment, and the remaining 190 lb. of silica fines was measured and supplied by hand methods from the the overhead bridge through an auxiliary pipe to the charging hopper.

When paving was progressing at a normal rate, the plant required more than 100 tons of gravel and sand per hour. Inability of the gravel supplier to furnish aggregate at the required rate limited the daily progress of the paving outfit. With an adequate supply of gravel, the job could make daily progress of 2,000 lin.ft. or better in 8 hr.

Concrete Delivery

Mixing specifications required 60 revolutions per batch by the mixer drums, driven by separate gasoline engines on the trucks. The specified mixing was accomplished in about 5 min., but even on short hauls the drums ordinarily were turned through 75 to 80 revolutions before the trucks pulled up beside the spreader to start discharging.

Traveling on the steel forms, the spreader received concrete discharged from a mixer and by means of the reversible screw mechanism distributed the material uniformly across the subgrade. The screw and the strike-off blade of the spreader were readily adjustable to place concrete in either of the two courses. As the spreader and the truck mixer moved ahead in unison, a workman regulated the flow of concrete from the mixer drum to maintain a fairly uniform load on the screw. The spreader was easily capable of handling concrete as rapidly as it could be delivered by the fleet of truck mixers.

A 2.66-cu.yd. batch was theoretically equivalent to 11.07 lin.ft. of slab for each 11-ft. lane of the 9-7-7-9-in. pavement. Lip curb 3 in. high (required along the inner edge of the pavement next to the median strip and, also, along the outer edge where the grade was 2 per cent or greater) took a small additional quantity of concrete, 1 cu.yd. being sufficient for 379 lin.ft. of the curb. Doweled transverse joints were installed at intervals of 60 ft. in the slab, ¾-in. premolded expansion joints being set 120 ft. apart, with contraction joints half way between them. Hook bolt dowels were used between the two lanes.

Finishing and Curing

After the spreader had deposited and roughly struck off the concrete for the top course, a Jaeger-Lakewood two-screed finishing machine ordinarily made two passes over the slab to impart the surface finish. The finishing machine carried a White gasoline-powered flexible-shaft vibrator

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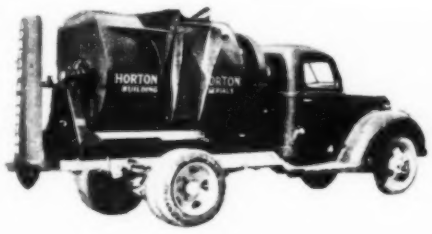

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610 ROSEDALE AVENUE, ST. LOUIS, MO.

which was used to vibrate the concrete along both edges of the slab ahead of the screed. Surface of the slab was broomed before concrete was placed in the monolithic lip curb.

To build lip curb, the contractor operated a self-propelled machine obtained from the Finn Equipment Co., Cincinnati, and later modified on the job to fit the working conditions. The machine was equipped with a hopper and a curb-forming blade which banked concrete against the 3-in. curb form.

Concrete was cured for 24 hr. under wet burlap of 7-oz. double thickness and then was covered with two-ply waterproof reinforced kraft paper which remained in place until beam tests gave a modulus of rupture of 600 lb. per square inch, ordinarily obtained in 5 days. Trucks were allowed to use the slab on the seventh day. A 1,000-gal. tank truck with a side spray bar wetted the burlap and saturated the pavement before the paper was laid. When not engaged on these operations, the truck sprinkled subgrade ahead of the concrete spreader. To wet dry subgrade when the tank truck was not available, the contractor mounted three 50-gal. drums and a spray-bar on the front of the concrete spreader.

Subgrade and Forms

To provide for a full day's run on the first lane, the job was equipped with 2,500 lin.ft. of Heltzel 9-in. steel forms and 2,500 ft. of 7-in. forms. A wood strip, fastened to the inner face of the 7-in. forms with the bolts of the hook dowels, formed a key slot in the inner edge of the slab.

A Carr formgrader cut the form trenches, and an R. B. finegrader operating on the forms trimmed the subgrade to desired profile, depositing the spoil on the shoulder. The subgrade was compacted with a Galion 5-ton roller.

Paving Organization

An excellent force of about 50 satisfied workmen built the concrete pavement. A 42-hr. work week was permitted, and the paving schedule was based on use of a 7-hr. shift 6 days a week. Actual working time had to be adjusted to fit job conditions.

Personnel

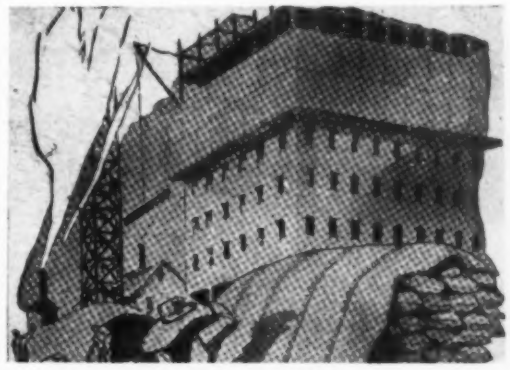
For the Ohio State Department of Highways the project was built under the immediate supervision of Robert G. Jones, project engineer, acting under the general direction of Edgar L. Mill, division engineer, and C. M. Sprague, assistant division engineer. Robert S. Beightler was director of the department at the time, and Hal G. Sours was assistant director and chief engineer. Mr. Beightler has since resigned to serve as commander of the Ohio National Guard in army training camp, and Mr. Sours is now director. Operations of the construction firms engaged in the work were carried out under the personal direction of Ralph Myers, Salem, Ind., contractor, and of Verne N. Holderman, of Hussey & Holderman, Columbus, Ohio, subcontractors on paving.

WHO STOPS ---

WHEN YOU'RE BUILDING A DEFENSE PROJECT

YOU OR WINTER ?

WORK CAN GO ON BEHIND CANVAS



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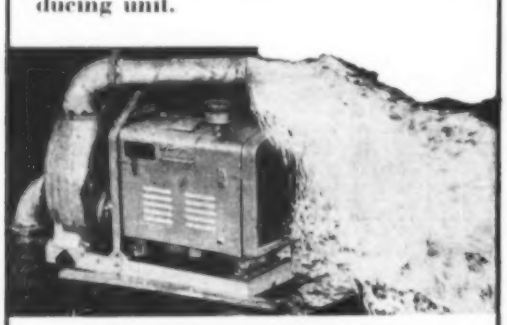

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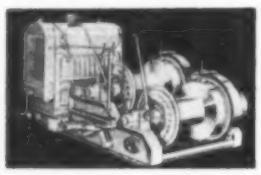

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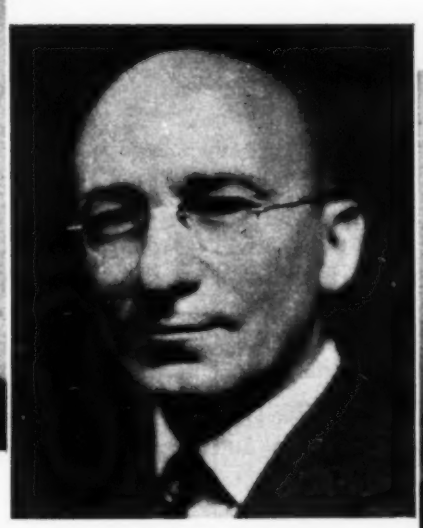
H. G. Sours, President, American Road Builders Association.

General Robt. Lee Bobbitt, of the Texas Highway Commission, will tell you how roads behave under military transport.



A. T. Goldbeck, Secretary of the Crushed Stone Association will discuss non-rigid pavements for airport service.

Prof. Walter Sadler of the University of Michigan brings you valuable data on the "Pitfalls of Bidding".

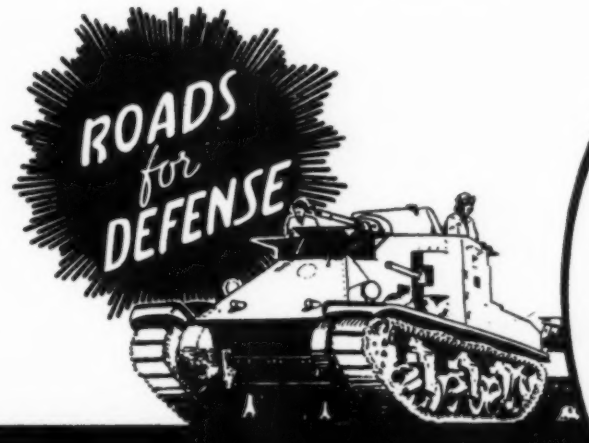
C. A. Hogentogler, Senior Highway Engineer of the Public Roads Administration, will tell you about engineering and construction control on highway embankments.

T. E. Stanton, materials Engineer, of the California Division of Highways, will discuss practices in the control of moisture in embankments and stabilized bases.

Capt. H. C. Whitehurst, Director of Highways for the District of Columbia, brings you a message on that coming new subject "City Street Maintenance by Contract".

Another new subject of heavy interest. H. H. Houk, Engineer of Washington National Airport, Civil Aeronautics Administration, will discuss airport engineering and the highway engineer.

Alan M. Williams, Engineer Manager of the Ionia County Road Commission, Ionia, Mich., will go into the important phase of legislation, finance and administration.



SPACE precludes our going into further details. These are but a few of the many topnotchers that are going to discuss many subjects pertinent to the problems of contractor and highway official alike. H. F. LaGuardia, Mayor of New York, Gen. Fugua, N.B.C. War Analyst, Frank Nikirk of the Caterpillar Tractor Co., E. E. Duffy, Francis J. Kelly, W. H. Seymour, H. F. Clemmer, are but a few of the many more that will discuss in detail the many things that affect your jobs. Don't miss it — *there will be interesting inspection trips, motion pictures, open discussion — fun! Make your reservation now. . . .*

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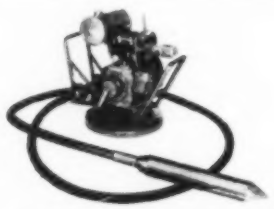

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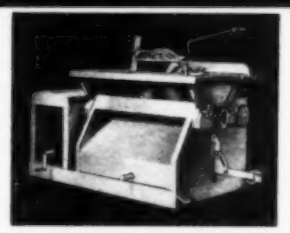

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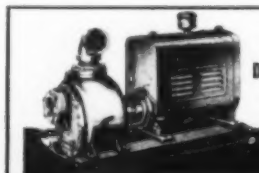

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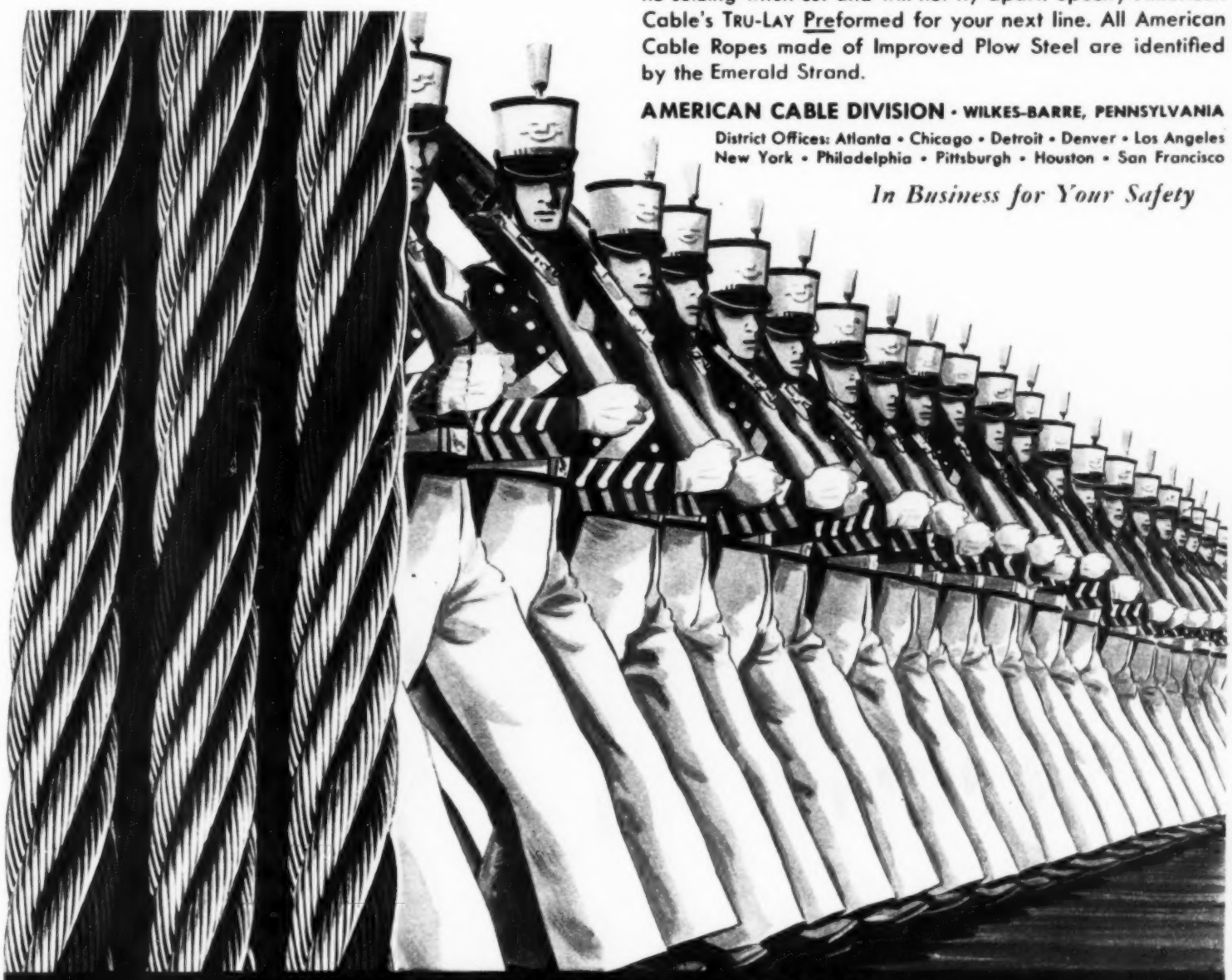

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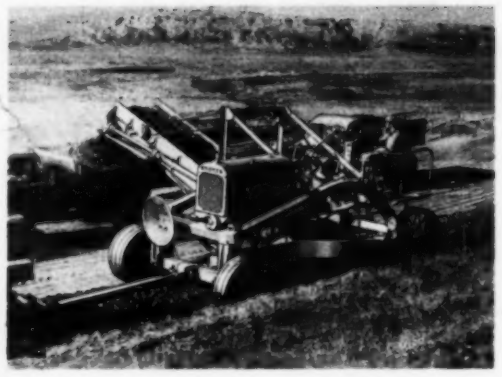

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